passive house+

eco build & upgrade

Wood works

Sloping site passive house raises design bar

Small but perfectly formed

Passive gem on tight Hackney site

From Victorian warehouse to passive hostel

insulation | airtightness | renewable energy | triple-glazing | ventilation | green materials | water conservation + more

Issue 16 £3.95
UK EDITION
ISSN 2009-597X

editor's letter

You're looking at the most substantial issue of Passive House Plus that we've published yet. It's no fluke either – it's a sign of a rapidly growing demand for reliable information on robust, comfortable, ultra-low energy sustainable building.

There is a very palpable sense of optimism and productivity among the cutting edge suppliers, contractors and designers we work with day-in day-out, which is thrilling to see. Remarkably, in both the Irish and UK editions of this issue, we've had more sign up from advertisers than we've ever seen before – which in turn means we can invest more back into the magazine for the benefit of readers.

Yet such optimism seems strangely inappropriate. In both Ireland and the UK – and in fact in large swathes of the developed world – we're in the grips of a profound housing crisis. For several years now we simply haven't been building anything close to a sufficient number of homes in places where people actually need them. The crisis has been exacerbated by land speculators sitting on land in good locations and starving the market of supply, pushing land prices in viable areas through the roof. Any developer looking to buy this land has to spend so much in so doing that it's hard to justify spending more than the bare minimum on construction costs.

The answer is to make high standards such as passive house mandatory, and to tax land in such a way that key undeveloped or underdeveloped sites come into play. If high standards are mandatory, then the extra construction cost isn't an extra cost at all, assuming land prices are high enough to take a hit. Mercifully in Ireland, the building regulations have tightened up so far that this is a moot point – we can find no difference between the cost of meeting minimum compliance or the cost of going passive – but in the UK the regs have much more ground to catch up. If – and it may be a big if – Britain votes to remain in the EU, the government will have to rapidly update building regulations to prepare for the EU deadline that all new public buildings must be nearly zero energy buildings by 1 Jan 2019, with all new buildings following suit two years later. These deadlines are absolute, and allow no transitional arrangements. That means a public building that's in the planning process now may need to comply with this law by the time it's built.

If anything, our attention on the architectural and constructional quality of buildings should be higher during a housing crisis. As a friend who spent the 80s and 90s architecting in London said to me recently: "I've lived through several housing crises. The housing they build now are the ones they'll be tearing down in ten years time." We must pay attention now more than ever.

We can take enormous heart from the growing interest among clients, designers, contractors and suppliers to embrace higher standards such as passive house – as the fact that two more Irish suppliers have gained passive house component certification demonstrates. As awareness of the standard spreads, as local supply chains develop and as misconceptions are debunked, passive house is starting to look increasingly attractive. It offers us a pragmatic, cost-effective route out of our nearly zero energy building quagmire that's proven to deliver genuinely low energy buildings.

Regards,
The editor

building knowledge

International PASSIVE HOUSE Association

iPHA

An official partner magazine of The International Passive House Association

FSC www.fsc.org MIX Paper from responsible sources FSC® C015417

Passivhaus Trust

The UK Passive House Organisation

Official partner magazine of:
The Association for Environment Conscious Building
The International Passive House Association
The Passivhaus Trust

Issue 16

PUBLISHERS: Temple Media Ltd.
PO Box 9688, Blackrock, Co. Dublin, Ireland
T: +353 (0)1 2107513 / +353 (0)1 2107512
Email: info@passivehouseplus.ie
www.passivehouseplus.co.uk

EDITORIAL


EDITOR:
Jeff Colley
E: jeff@passivehouseplus.ie


DEPUTY EDITOR:
Lenny Antonelli
E: lenny@passivehouseplus.ie


REPORTER:
John Hearne
E: john@passivehouseplus.ie

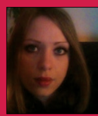

REPORTER:
Kate de Selincourt
E: kate@passivehouseplus.ie


REPORTER:
John Cradden
E: cradden@passivehouseplus.ie


UK SALES
Stephen Molyneux
E: stephen@passivehouseplus.co.uk


READER RESPONSE / IT
Dudley Colley
E: dudley@passivehouseplus.ie


ACCOUNTS
Oisin Hart
E: oisin@passivehouseplus.ie


ART DIRECTOR
Lauren Colley
E: lauren@passivehouseplus.ie

CONTRIBUTORS

Ben Adam-Smith, journalist | Nessa Duggan, Rightify Andy Hamilton, sustainable energy consultant | Andy Lundberg, Passivate | Andrew Michler, Baosol llc Adaptive Building Consulting | Peter Rickaby, Rickaby Thompson Associates

GRAPHIC DESIGN: Creative Box
www.creativeboxdesign.com

PRINTING: GPS Colour Graphics,
T: +44 (0) 28 9070 2020
www.gpscolour.co.uk

Publisher's circulation statement: Passive House Plus (UK edition) has a growing print run of 11,000 copies, posted to architects, clients, contractors & engineers. This includes the members of the Passivhaus Trust, the AECB & the Green Register of Construction Professionals, as well as thousands of key specifiers involved in current & forthcoming sustainable building projects.

Cover: Casa LLP
Photo: Adria Goula Sarda

ABC

ABC Certified Average Net Circulation of 9,140 for the period 01/07/14 to 30/06/15


DEPEND ON:
structural strength
vapour tightness
air tightness
certification
technical support
sustainability

contents

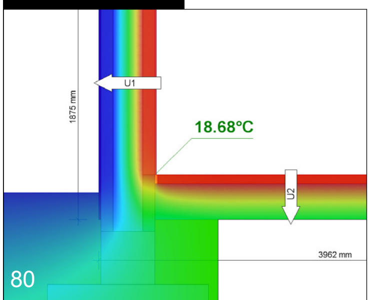

28


33


34


54


62



80

News

UK Centre for Moisture in Buildings launched at UCL

An initiative aiming to increase knowledge and understanding of the issues moisture can cause in buildings old and new, was launched in London on 26 May. The UK Centre for Moisture in Buildings (UKCMB), backed by University College London and other academic institutions plus the BRE, plans an ambitious programme of research, public engagement, policy work and training to improve moisture safety.

Speaking at the launch, UKCMB director Neil May explained that, compared to the extensive research into energy performance, there is very little research into moisture in buildings. The centre had been set up to change this, and, importantly, to increase understanding of the real-world impact of moisture issues – not only to challenge practices and assumptions that lead to moisture damage, but importantly, also to quash scare stories: "It's about balance," May said.

Neil May is especially keen to engage with both regulators and, importantly, insurers. "They are the drivers, the ones who can make change happen." An early output of the centre will be a white paper to be published by the British Standards Institute, proposing a wholesale revision of the approach to moisture risk assessment.

The UKCMB is taking its lead from the equivalent body in Sweden, the FuktCentrum ("Moisture Centre"). Representatives from FuktCentrum attended the launch, and described their work on a number of Swedish building moisture issues that are shared in our cool, wet climates, including construction moisture, damp crawl spaces, and the challenge of evaluating moisture safety with new and unfamiliar materials.

The Swedish delegates also described the construction moisture safety protocol they have developed. In it a moisture safety champion is appointed who checks and, crucially, documents moisture safety aspects of the entire build – including for example measuring the moisture content of materials on site – to demonstrate that attention has been paid to moisture risk throughout the build. The UKCMB hopes to develop similar protocols for adoption in the UK: "What is needed is not so much hard, prescriptive guidance, as intelligent procedures that can tackle a range of situations," May said.

Researchers and professionals with an interest in the subject of moisture in buildings are invited to get involved. More information is available at ukcmb.org, and the group can be contacted at ukcmb@ucl.ac.uk

(Above left) UKCMB director Neil May speaking at the new organisation's inaugural event in May

Architype progress 80-unit passive house project in Hertfordshire

Outline planning permission for an extra care residential scheme has been granted in rural Herefordshire, following submission of a highly sustainable passive house design by Architype architects to provide up to 80 high-end apartments in Whitestone.

Commissioned by local independent developer, Collins Design & Build, the scheme hopes to address the shortage of suitable housing for older people in the county, offering residents an active and healthy lifestyle as well as high quality homes for life.

The arrangement of one, two and three bedroom homes is designed with a communal focus, promoting natural surveillance for neighbouring residents, supported by a live-in warden to aid independent living.

The passive house standard has been specified to minimise energy bills, maximise daylight, and create a highly comfortable living environment. With passive house design, stable temperatures and internal conditions can be achieved year round, which is often critical for the health of older people, as suggested in a recent study by PhD student Frederico Tartarini. Architype said this timely study, which was covered in the Guardian newspaper recently, is further evidence that optimal temperature and humidity contribute to better quality physical and mental health.

Residents will be able to partake in the on-site communal leisure facilities, including a swimming pool, sauna, gym, sports room, putting green, croquet green and petanque pitch. The scheme also makes potential provision for a café, shop, hair salon, craft room, medical and wellness facilities, library and IT room, to encourage social interaction, an active lifestyle and a strong sense of community.

The landscaped gardens respond to the already established trees to provide privacy for residents, who will be able to enjoy both views from their apartments over trees and ponds, as well as the physical and mental health benefits of hands-on gardening across the ten allotments.

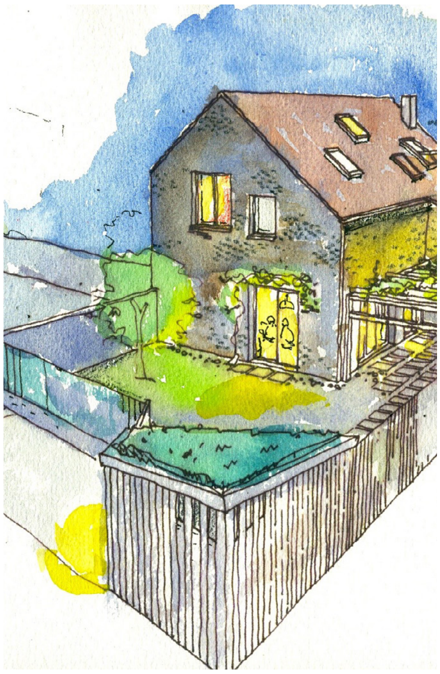
Car parking spaces are provided as near as possible to the apartments for residents with limited mobility and to meet Lifetime Homes Standards. The next step will be to develop a detailed design with the expert advice of specialist care providers.

(Above) Architype's proposed passive house extra care scheme for Collins Design & Build in Whitestone

News

2016 Passivhaus Awards features best in British passive design







The shortlist of projects for this year's 2016 UK Passivhaus Awards has been announced. There are just two categories this year, urban and rural, with Rehau being the main sponsor.

In the urban category, sponsored by Ecology Building Society, the shortlisted projects are Chiswick Eco Lodge by RDA, Lansdowne Drive in Hackney by Tectonic Architects (featured in this issue of Passive House Plus), and Meeting House in York, by Anne Thorne Architects.

In the rural category, sponsored by Cygnum Timber Frame, the shortlisted projects are the Golcar passive house in Huddersfield by Green Building Store, the Lime Tree passive house in Norfolk by Parsons & Whittley, Tigh na Croit passive house in the Scottish Highlands by HLM Architects, and the Old Water Tower passive house in Berkshire, by Gresford Architects, which featured in issue 15 of Passive House Plus.

The award ceremony takes place on 7 July in London. For more information see www.passivhaustrust.org.uk.

(Above from left to right) Shortlisted in the urban category are Chiswick Eco Lodge; Lansdowne Drive in Hackney; and Meeting House in York; while the rural shortlist includes Golcar passive house in Huddersfield; the Lime Tree passive house in Norfolk; Tigh na Croit passive house in the Scottish Highlands; and the Old Water Tower passive house in Berkshire

News

Schöck offers low thermal bridging alternative to wrapped parapets

It is well documented that parapets allow conductive materials to transfer energy through the thermal barrier and are therefore just as prone to the problems of thermal bridging as balconies.

In the majority of cases, the conventional method of insulating parapets is to wrap the perimeter of the wall with an insulation barrier. This is costly and has associated long term risks. However, the new Schöck Isokorb type AXT offers a cost-effective and more thermally efficient alternative. Its 120mm insulation thickness results in low psi-values and therefore significantly reduces heat loss – and there is no wrapping required. It permits a more sophisticated construction opportunity for greater freedom of design, and allows flexible distance between elements according to load requirements. An added benefit is that there is no risk of any additional thermal bridging through balustrade fixings.

Other key factors in the selection criteria for suitable solutions are durability and water impermeability. The Isokorb type AXT solution does not require maintenance and there is no risk of expensive restoration due to waterproofing problems. Wrapped components are similar in principle to an insulated flat roof, with many of the associated problems. They are prone to damage and almost inevitable repair and maintenance outlay, particularly where railings or covers pierce the insulating layer. With thermally separated parapets, railings and covers can be attached directly into the concrete.

The Isokorb type AXT is a certified passive house component, comes with BBA certification, LABC registration and NHBC approval, and meets full compliance with the relevant UK building regulations. The temperature factor used to indicate condensation risk for occupants in residential or commercial buildings – the (fRsi) value – must be equal to or greater than 0.75 or 0.50 respectively, and is comfortably met by incorporating the Isokorb. In addition, the systems also aids compliance with the government's Standard Assessment Procedure, SAP 2012, concerning CO2 emissions from buildings, including heat losses through non-repeating thermal bridges.

For your free copy of the new Thermal Bridging Guide and or the Schöck Specifiers Guide, visit www.schoeck.co.uk.

(Above left) The Schöck Isokorb type AXT will help to reduce heat loss at parapets

Screed standards key to preventing failures, advise Smet

Smet Building Products has advised those specifying floor screed to avoid product failure, particularly in heated screeds, by ensuring their choice of products meets the right standards. "Historically, floor screed failures have regularly resulted from the interaction of heated screed constructions with a wide range of coverings. Failure by the contractor to check on residual moisture and consequent installation of coverings on an overly wet screed may have serious implications for the durability and longevity of the flooring," said Joris Smet of Smet Building Products.

The maximum permissible residual moisture (measured using CM tester) is 2% for cementitious screeds and 0.5% for calcium sulphate screeds, Smet said. He added that apart from measuring the residual moisture in the substrate, the contractor should also examine the commissioning report for the floor heating system and inspect the screed for possible cracking. The commissioning procedure serves to check the performance of the floor heating system and screed.

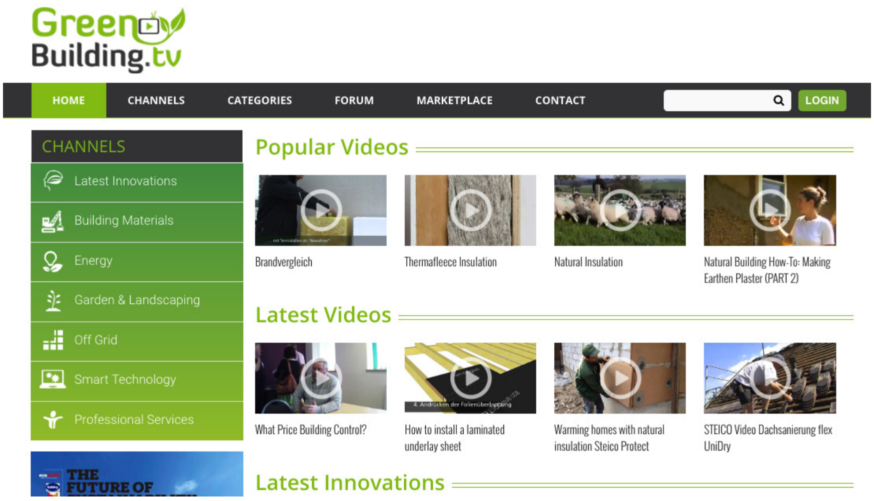
Heated screeds are a floating screed guided by BS 8204-1, BS 8204-7 or DIN 18560 Part 2, where the floating screed layer is installed over underfloor heating pipes. The screed serves to conduct the heat evenly across the floor surface, avoiding hot or cold spots. In order that heat propagates only in the required direction of the room to be heated or cooled, the elements are inserted above insulating panels.

Heated levelling screeds are generally laid in conjunction with proprietary underfloor heating systems as floating screeds over thermal insulation. The heating pipes or cables should be secured in position; their installation details should be provided by the manufacturer of the heating system. Cementitious levelling screeds should be laid at the thicknesses recommended in 6.4.3c of BS 8204-7 (75mm minimum or 65mm for domestic applications) unless otherwise specified by the manufacturer of the proprietary system. For information on Smet's range of innovative screed products, see www.smetbuildingproducts.com.

(Below) The Sopro Rapidur B5 fast drying screed binder, available in the UK and Ireland via Smet, retrofitted here over 3500 sqm of underfloor heating at Our Lady of Lourdes Hospital, by Smet approved installer Brendan Doherty Screeding Services

News

New online green building video platform launches



Green Building TV, a new community platform that uses video to communicate ideas, products and services between buyers and sellers — all relating to the sustainable construction sector — is set to go live in mid June.

According to Green Building TV's Carl Munson, the new platform is a "compendium channel designed to put two people together. People who have something that can solve a problem, with people who have a problem to be solved."

Munson said Green Building TV has been created to offer distraction free viewing for the public, with all the information they need in one place without any irrelevant advertising and content. It also provides a platform for suppliers to reach and engage with the right audience.

As a community platform, suppliers are incentivised to contribute by adding video, respond to questions and solicit reviews from their clients. "This keeps the information fresh and relevant for the community," Munson said. The audience can comment and rate content and suppliers, and can also contribute by sharing their project experience and knowledge in the forum.

The user experience has been designed to be intuitive, with information, at a glance, easy to find and understand. There are three main sections to Green Building TV.

The channels is a library of video content which covers every aspect of sustainable construction. From building materials to smart technology, and from off grid to the latest innovations, videos have been grouped together to make them easily searchable.

The marketplace is where suppliers each have a directory listing that includes company details, contact information, and videos about the products and services they offer. As this is a community platform, people can leave reviews where they can rate suppliers. They can also ask questions to specific suppliers right in the marketplace.

Meanwhile, the forum is a community space for asking questions and finding information. It is designed to connect people who have knowledge and experience, together with people who are looking for it, and for users to generally get help with their projects.

"If you're planning a sustainable build or renovation project, or are a supplier to the sustainable building sector, Green Building TV is the place to be," said Munson. It is entirely free to view and available at greenbuilding.tv.

Ancon adds new wall tie to Teplo low energy range

Fixing specialist Ancon has launched a brand new ultra-low thermal conductivity wall tie.

Based on the company's multi-award winning TeploTie with a conductivity of 0.7W/mK, which virtually eliminates heat loss through thermal bridging in cavity wall construction, the new Teplo-BF basalt fibre wall tie features specially moulded safety ends that improve buildability and enhance mortar bond strength by up to 80%.

The new user-friendly design has exceptional mortar grabbing capability, making Teplo-BF particularly suitable for use with lime and other slow-drying mortars.

The Teplo-BF, like the original TeploTie – which was introduced into the UK and Ireland by Ancon in 2010 and since used on a number of ground-breaking passive house and zero-carbon buildings – is created by the setting of innovative pultruded basalt fibres in a resin matrix. This composite material provides a combination of high strength and outstanding thermal efficiency.

The ultra-low thermal conductivity, twenty times below that of stainless steel, means that Teplo-BF ties are excluded from U-value calculations to BS EN ISO 6946, helping to minimise insulation and wall thickness, a particular benefit in modern low-energy construction applications.

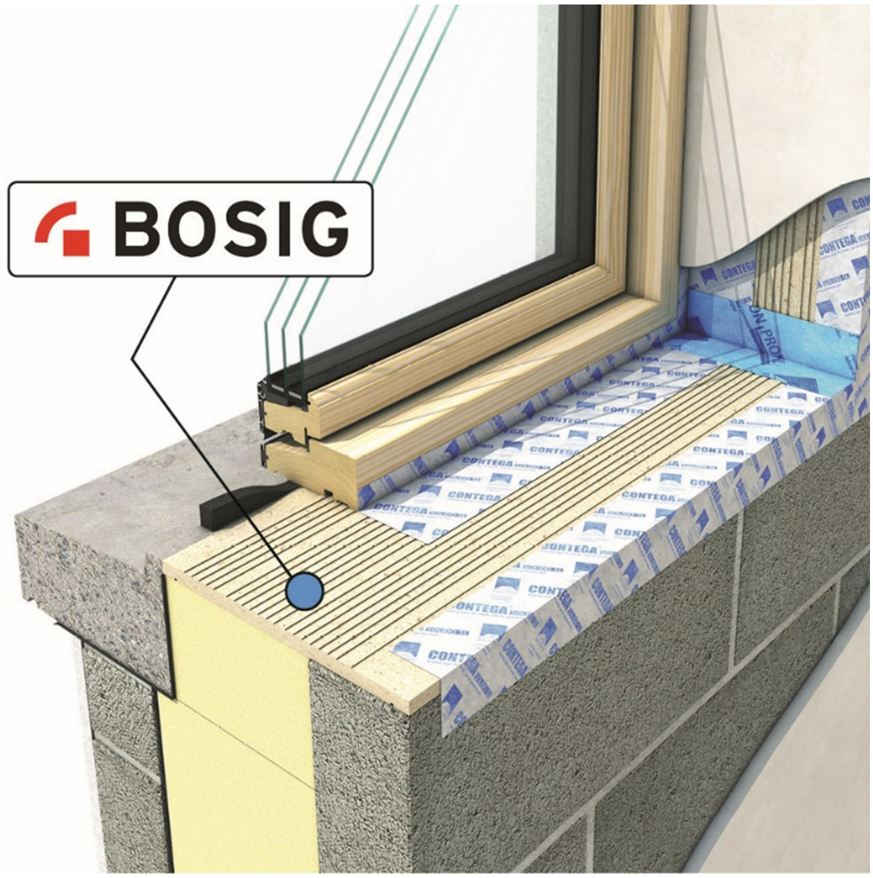
Available in the same wide range of lengths and types as the original TeploTie, the new Teplo-BF wall tie is suitable for cavities up to 450mm wide and buildings up to 18 metres in height, and carries BBA and NHBC technical approvals.

Ancon marketing manager Annabelle Wilson, said: "Following discussions with building contractors, Ancon identified a need for a more user-friendly design, offering a more robust bond that is better suited to the general site environment, and greater versatility in the choice of mortars with which Teplo ties can be used. The new Teplo-BF not only meets these requirements but the new moulded ends make these ties safer for bricklayers to work around too."

Wilson said this range extension provides the market with three distinct Teplo options – the original TeploTie for new-build applications and resin-fixing into an existing structure during retrofit, the Teplo-L-Tie for surface fixing to an in-situ structural frame, and the Teplo-BF, an improved new-build cavity wall tie with high bond strength even in slow-drying mortars and moulded safety ends. "Ancon's comprehensive wall tie range includes a low thermal conductivity fixing for almost any masonry construction project," she said.

News

Ecological launches thermal bridging solution



Ecological Building Systems has extended its innovative range of thermal solutions to include Bosig Phonotherm 200, a compressive resistant thermal insulation. Bosig, the manufacturer of Phonotherm 200 was founded in Germany over 35 years ago.

Phonotherm 200 is a formaldehyde-free 100% upcycled polyurethane thermal insulation whose raw material is sourced as a by-product from white goods, in the motor and thermal insulation industries. From an ecological perspective, Phonotherm 200 utilises raw materials which would otherwise end up in landfill and the manufacturing process is carried out in accordance with the environmental standard ISO 14001. In this way the product compliments the range of ecological solutions Ecological Building Systems supply.

With increased requirements to address thermal bridging at critical junctions such as windows, doors & foundation, Phonotherm 200 offers homeowners, builders and specifiers a robust, practical and effective thermal solution.

Niall Crosson, senior engineer with Ecological, said: "It is well known that thermal bridging has a negative impact on the thermal resistance of building elements, along with the additional risk of condensation and mould growth, and the resultant deterioration in indoor air quality. Ecological are delighted to supply a solution to address thermal bridging at key junctions which is not only effective, but also more ecological compared to alternative materials as it is sourced from a raw material which would otherwise go to landfill."

Ecological will also supply complete thermal bridging analysis and support to designers and specifiers from their technical department, to complement their existing hygrothermal, U-value and dew point assessment service.

Phonotherm 200 is primarily utilised for applications where structural support and the possibility of obtaining secure fixings into the material are required. Phonotherm 200 is 100% water resistant, diffusion open, easy to machine with conventional carbide tools, and effectively reduces thermal bridging at critical junctions.

(Above) A section view of a cavity wall insulated with Phonotherm 200 thermal breaks to cut thermal bridging at the window sill

New sales manager appointed

In further news, the company has increased its team with the appointment of Neil Turner as technical sales manager.

A BBA-competent U-value assessor who has been involved in developing CEN (Comité Européen de Normalisation) European standards, Neil brings more than 14 years' experience in the building products sector to Ecological.

He joins the company from a manufacturer where he worked with architects, contractors and timber frame specialists on the specification of sustainable insulation products, and has been involved in projects using Ecological's products for many years, giving him an excellent knowledge of the company's portfolio.

Neil will now use his experience, understanding of the sustainable construction market and industry contacts to drive uptake of Ecological Building Products' wide ranging portfolio, which includes Pro Clima airtightness and wind-tightness solutions, Gutex insulation, Calsitherm climate board and Diasen thermal plasters. He will also work with stockists and distributors to continue to expand Ecological Building Systems' supply network across the UK.

Penny Randell, UK director of Ecological Buildings Systems commented: "Attracting Neil to join us is a major coup for the company because he is so passionate about sustainable and passive house construction, is very familiar with 'diffusion open' buildings and has significant experience across our product range.

"His wealth of technical expertise and experience of a diverse range of construction methodologies will make him a valuable resource for our customers and will help us to continue to grow the business and extend the reach of our products."

Neil adds: "This is an exciting time for Ecological Building Systems as the industry's appetite for a fabric-first approach to lower carbon buildings is really gathering pace.

"Being involved with a company that has such a diverse combination of complementary products is a great opportunity and I'm looking forward to engaging with customers."

(Left) Ecological's new technical sales manager, Neil Turner

News

Viessmann installs ice store heating system in Huf Haus

Leading international sustainable technology manufacturer Viessmann has collaborated with high end prefabricated house manufacturer Huf Haus, to equip a UK residential property with first-of-its-kind technology.

Viessmann's innovative ice store system, which recovers energy exclusively from renewable sources to heat or cool a building and to heat domestic hot water, has been installed as an integral part of a new phase of sustainable residential architecture being demonstrated at the first UK Huf Haus show home, at Brooklands near Weybridge in Surrey. The show home has been open to the public since September last year.

The Viessmann heat pump extracts energy, as needed throughout the year, from water stored in the ice store. As this energy is used, especially during the winter heating season, the temperature of the water in the ice store falls. If the temperature in the store falls to freezing point, additional energy is obtained from the freezing of the water — hence the term ice store.

Freezing is an exothermic process, meaning that as liquid changes to solid, crystallisation energy (latent heat) is released. This latent heat is retained in the ice store system. A standard 10 m^3 ice store for a detached house generates a heat gain equivalent to about 100 litres of fuel oil and is capable of 10 kW of heating output. Because the amount of latent heat released is equivalent to that required for the inverse process of thawing, in effect there is 100% energy transfer and zero losses over time.

In summer the ice store can also be used to provide natural cooling for the building's interior. The Huf Haus show house in Weybridge is characterised by the expanse of glass synonymous with Huf Haus architecture, utilising what the company claims are unparalleled insulation, airtightness and fabric efficiency to ensure the floor-to-ceiling windows flood the interiors with natural light without compromising energy efficiency. In addition to the ice storage system taking heating and cooling technologies to the next level, the house's photovoltaic panels on the south-facing roof are guaranteed to generate more electricity than the house needs, allowing surplus energy credit to power an electric car at the electrical 'fuelling' station at the front of the house.

(Above) The heat pump in the Huf Haus showhouse in Weybridge takes water from the ice store to generate heating, cooling and hot water

Urban Front integrates passive pet flap in Oxford passive house

Buckinghamshire-based passive house door manufacturer Urban Front can now integrate airtight, insulated, thermally broken Petwalk pet flaps into their door systems, as one of the company's latest door projects shows.

The Petwalk pet flap was recently incorporated into one of Urban Front's doors on a passive house project in Oxford.

The pet flap can be naturally integrated into the appearance of the door with the same finish, so it does not create an eyesore. Petwalk also has a remote control for you to lock it if you need to, and security bolts to ensure no-one or nothing else other than your pet can enter.

Urban Front manufactures the Front e98 Passiv, a passive house certified door with an overall U-value of 0.8.

(Right) An Urban Front entry door with discretely integrated Petwalk pet door in a passive house in Oxford

News

Xtratherm extend thermal bridging solutions for passive masonry construction

As part of their full fill insulation system, Xtratherm have further extended their CavityTherm offering, a continuous wall insulation system delivering ultimate thermal performance. Achieving passive level U-values as low as 0.12 with excellent thermal bridging detailing in cavities less than 150mm wide, CavityTherm comes with an extended range of accessory pieces to ensure a continuous insulation system, ensuring best practice thermal bridging details, all verified under the BRE accreditation system.

The full CavityTherm range, along with all accessory pieces deliver unrivalled continuity, making detailing easier to achieve and inspect on site. Danny Kearney, technical director with Xtratherm, explains that "insulation performance cannot simply be assessed in terms of thermal conductivity or a simple U-value. How insulation interconnects with other components and other building elements is even more critical than achieving an additional U-value increment when we are building to passive levels. This is well understood in passive circles, the task is to achieve the same understanding in the construction field generally."

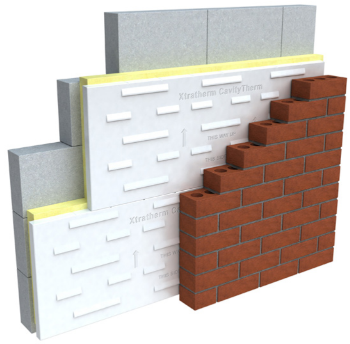
Xtratherm published their first guide to thermal bridging in 2002, in which they identified the important of detailing early on. Mark Magennis, who heads up their technical team on the subject, was also the first person in the UK and Ireland to be qualified under the official modeller scheme.

Danny Kearney added: "ACDs cover the most obvious junctions where thermal bridging heat loss occurs in domestic construction, insulating these junctions properly saves the vast majority of energy lost at junctions; but by modelling in 3D — as we do — also ensures that the possibility of condensation forming is analysed and avoided within the calculation process. For this reason we need to look at all junctions to avoid condensation at these less obvious junctions."

The CavityTherm system includes accessories to effectively insulate these "fiddly bits" (such as stepped cavity trays, meter boxes, hockey sticks and service voids). Kearney said: "'Industry has started to step up to the mark and cooperate with bodies such as NHBC, RIBA and other manufacturers of concrete, radon barriers, windows and lintels to agree how our systems work together."

"Thermal Bridging is not as complicated as some would tend to expect, it's down to simple common sense, it's about insulation continuity. Identifying and effectively thermal wrapping any thermal bridge will alleviate the majority of problems. I think that industry needs to promote education in areas of identification and reasonable treatment of building detailing to encourage better practice on site. To this end Xtratherm have developed the Xi Training Academy and exhibition area in Holmewood, where best practice detailing plays a large part."

(Below) Xtratherm's CavityTherm insulation system comes with a suite of thermal bridging details to ensure compliance with building regulations while protecting against interstitial condensation risk



Lunos low energy ventilation units pick up awards

Innovative ventilation supplier Lunos has picked up awards for its decentralised heat recovery ventilation and demand-controlled ventilation systems.

The company won Plus X Awards for its e²neo and Nexxt decentralised heat recovery ventilation systems, and for its Silvento EC demand-controlled ventilation systems.

According to Lunos: "Not only is the e²neo one of the very few ventilation units achieving the energy efficiency class A+, but now it is also winner of the Plus X Awards in the categories high quality, design, functionality and ecology." Meanwhile the Lunos Nexxt fan and Silvento ec DCMEV system both won best product of 2016/2017 at the awards, which the organisers claim are the world's largest innovation awards for technology, sports and lifestyle.

"The new e²neo with heat recovery is even quieter and has improved levels of efficiency," the company said. Lunos developed the e²neo based on the well-established e² system. The company said the new system functions silently at rates of 5 m^3/h, facilitated via a newly developed motor. "In addition to a considerably reduced operating noise level [the new motor] also enables more precise regulation." This means it is not only quieter than the lower-priced e², but also more efficient. The company added that the familiar, reliable effectiveness of the e² is still available, but that the e²neo can operate at 0.3w – making it one of the most cost-effective ventilation units worldwide.

A new generation within the Silvento DCMEV range, Lunos said the Silvento ec requires less energy, since power input has been considerably reduced as a result of ec engineering. It is quieter than its predecessor, since it operates far more efficiently and can be operated with lower volume flows. The lowest ventilation level is 15 m^3/h.

Two different technical modules are available to control the Silvento ec: a basic module and humidity module. With the basic module, all stages of the Silvento ec can be selected and combined with time lag, interval switching and delay time. With the humidity module, the system gains additional humidity and temperature sensors. "There has never been a more sophisticated, individual humidity control," said the company. The Silvento can operate at 1.8w making it one the most cost-effective ventilation units worldwide.

The new Silvento ec is 100% compatible with all Lunos parts, to ensure that all devices can, if required, be swiftly and easily replaced with new devices.

Lunos is distributed in the UK and Ireland via Partel.

(Above) An exploded view of the award-winning Lunos e²neo decentralised heat recovery ventilation unit

News

Thermoblock features in high profile Leicester Square retrofit

The refurbishment of a landmark listed property on London's Leicester Square has seen Marmox Thermoblocks specified in very large quantities for an unusual application. Number 48 Leicester Square is being completely redeveloped behind the retained 1920s stone façade, with Make Architects leading the design team on behalf of client, Linseed Assets, while Pacific Construction is the main contractor. When complete the remodelled property overlooking one of the capital's most famous public realms will offer 186,000 square feet of usable space over seven new floors of offices with retail units at street level.

There will also be accommodation on a newly created upper storey, behind what Make Architects describe as a fresh interpretation of the traditional mansard roof. Pivotal to this radical reconstruction has been the need to stabilise and strengthen the outer elevations which had been badly weakened by previous alterations over the past century. With a full façade retention structure in place and the basement area framed by a retaining wall, the project team's solution involved raising an internal inner blockwork wall using aerated concrete. This is intended to improve the thermal performance of the exterior elevations as well as their regularity and soundness, while taking up the minimum interior space. As part of this, the project team elected to make use of the Marmox Thermoblocks as a means of minimising heat loss at the critical floor wall junction.

The 600mm long insulation units incorporate mini columns of high strength, low conductivity concrete to support the load of the wall above while the low lambda value insulation virtually eliminates the path for cold-bridging. The blocks are laid using normal bricklaying mortar with special Marmox Multibond sealant used to secure and seal the stepped joints, while an integral layer of mesh on the upper and lower surfaces offers a good mortar bond for block-laying to continue in the conventional manner. In total over 1000 Thermoblocks were supplied by the Islington branch of Travis Perkins, helping to create a continuous horizontal thermal break beneath the new wall rising from the basement of 48 Leicester Square, ensuring it will meet the current building regulations and that the structure will endure for many decades to come.

(Below) Thermoblocks being installed in No 48 Leicester Square to provide structural support without compromising on thermal performance

Cellulose insulation improves airtightness by 30% — PYC Systems

In October 2015, PYC Systems carried out the first of several air tests at the Hilltop project in Richard's Castle on the Hertfordshire—Shropshire border, Architype's first small scale residential passive house project. The first blower door test result was 0.59 air changes per hour (ACH), prior to insulating the envelope, which everyone was keen to improve on as it only marginally passed the passive house standard and was prior to fitting services, which are known to increase the risk of air leaks.

Warmcel cellulose fibre insulation was then installed to a depth of 300mm in the walls (from the outside) and 400mm in the ceilings, injected from the inside of the property. Following the Warmcel installation a second blower door test was completed and a result of 0.41 was achieved, an improvement of 30%.

"Having hard evidence to confirm previous understanding that Warmcel can give heightened levels of airtightness is great news, really helping to secure the best results that are needed for passive house," said Rich Hibbert of PYC. Juraj Mikurcik of Architype was there for the blower door tests, and tweeted from his @JurajMikurcik handle: "Installing Warmcel makes a difference. Original BDT 0.59, today's re-test 0.41 ach. Pleased with the 30% improvement."

PYC Systems also pointed to European research which found that fitting cellulose insulation improves airtightness (see tinyurl.com/gpybz9j). PYC Systems has carried out several pre and post cellulose fibre insulation installation tests, and the results have been consistent – cellulose fibre insulation will improve airtightness in the building fabric. PYC said the complete full fill and high density application (up to 60kg/m^3) within the timber frame means that not only will the insulation perform to a high level by cutting out convection looping, it will reduce any potential for air flow through the fabric on average by 30%.

(Left) A blower door test under way at the Hilltop project in Richard's Castle

News

SmartPly and ProAir get passive house certification in boost for Irish manufacturers

Two leading Irish manufacturers of passive house components have both received passive house certification for their systems.

Coillte subsidiary SmartPly has received certification for ProPassiv, its wood panel system for ultra low energy buildings, formerly known as VapAirTight. Meanwhile, Galway manufacturer ProAir has received certification for its PA 600 PLI heat recovery ventilation system.

The awards were presented by Passive House Institute director Prof Wolfgang Feist at this year's International Passive House Conference in Darmdstadt, Germany.

The result of three years' vigorous development, each SmartPly ProPassiv panel features alternating layers of wood strands coated with a high quality formaldehyde-free resin system and wax to deliver outstanding levels of airtightness. A specialist coating is then applied to provide vapour control properties to ensure a premium performance OSB solution for super-insulated and passive buildings.

"OSB is assumed to be airtight, but tests showed a huge variation in performance, between manufacturers," explained David Murray, innovation manager at SmartPly. "Developed from our OSB3 system, SmartPly ProPassiv has been proven to achieve the highest levels of airtightness required to meet the passive house standard."

Available in a standard 2397mm x 1197mm size, the panel's smooth and durable surface has also been developed to provide "superior bonding of airtight tape at panel joints". Murray said that where air and vapour control layer (AVCL) membranes are difficult to seal, ProPassiv offers excellent seal adherence to prevent air leaks, condensation and consequential structural damage.

Meanwhile ProAir's PA 600 PLI heat recovery ventilation system has recently achieved certification after strenuous testing. The unit is certified by the institute to have a heat recovery rate of 86%. The company recently moved to a 7,500 sq ft facility on the edge of Galway City where it manufactures a family of heat recovery ventilation units.

The testing for certification was carried out at the BRE facility in Watford. "Dr Mick Swainson who oversees the Appendix Q testing, took a very personal interest in getting this first passive house test right," ProAir's David McHugh wrote in a blog post on the Passive House Plus website.

"Eventually the tests were completed in the second half of 2015 and the due diligence by the Passive House Institute then went through its process," McHugh said.

(Above) Pictured at the International Passive House Conference are (l-r) ProAir MD David McHugh, Passive House Institute founder Prof Wolfgang Feist and SmartPly innovation manager David Murray

News

Planning granted for new passive house in listed parkland


Casa Architects has achieved NPPF 55 status for the development of a new passive house in a listed parkland near Frome, Somerset. NPPF 55, recognised as one of the most difficult planning applications to achieve, sets strict planning restrictions to allow only truly outstanding or innovative architecture of the very highest quality and standard to be built in the English countryside.

The house is proposed as an exceptionally high standard sustainable building with a minimal environmental footprint both in construction and in use. Casa Architects' design includes a fabric-first approach to deliver a highly insulated and airtight construction to achieve the passive house standard; use of natural, unprocessed materials as much as possible; careful orientation of the building to optimise passive solar gain and minimise heat loss through the glazing; and on-site energy generation with solar photovoltaic panels.

"Integration of the landscape and architecture is critical to the success of this house," said Ian Walker, director of Casa Architects. "This is an extraordinary site, where open parkland sweeps up to the southern timber and glass side of the house, while woodland wraps the stone side that also address the nearby public road."

A single timber clad opening clearly defines the entrance and adds a contemporary element to an otherwise restrained, monumental stone facade. Double height stone walls extend toward the landscape and beyond the roof edge to fully embrace the timber body.

The articulated tower façade is vertically and horizontally broken as an homage to the tree canopy backdrop, serving to blur the boundary between landscape and building, which in further re-enforced by the integrated landscape design.

The building mass is intentionally restrained to reflect the generally two-storey nature of nearby buildings. The plan shape also serves to break down the volume by restraining the observable volume from any given direction. The use of natural and local stonework, characteristic of the nearby buildings, is an important reference to the rural context. Windows to the public face are kept modest with vertical proportions, a design response that both reflects the nature of the local building style and helps reduce heat loss on north-facing elevations.

The South West Design Review Panel guidance letter in support of the design observed: "We welcome the house as a demonstration that good, strong, contemporary architecture can sit harmoniously in a rural setting close to heritage assets." The project is expected to go to site in the autumn of 2016.

(Above) Illustrations of the proposed Casa Architects-designed passive house near Frome, Somerset

Passive house taking off in the South Pacific, conference hears

Passive house indeed works everywhere was the core message at the second annual South Pacific Passive House Conference, *writes Andrew Michler*. The conference was held in Melbourne on 12-13 February. While just a handful of passive houses have been completed in Australia so far, a sizable contingent from New Zealand came to the conference armed with multiple examples of how even warm climate buildings benefit from the energy savings, comfort and critically the health of a passive house. With a major spike in asthma from damp and mouldy homes, the principles such as airtightness, controlled air exchange, and thermal bridge free design are finally being accepted as the best solution in this part of the world.

Melbourne is in fact a heating climate, and when I was there the summer days were cooler than winter in Los Angeles. North American Passive House Network co-president Bronwyn Barry's keynote featured a close look at half a dozen homes built to the passive house standard in Palo Alto, just south of San Francisco. And just like the famously chilly city by the bay, Melbourne suffers from a building stock plagued by uncontrolled 'natural ventilation', poor windows and low insulation levels — all which means uncomfortable and energy intensive buildings.

This was not news to the 150 participants who packed the workshops, lecture hall, and swarmed the exhibitors. So while the concepts of deep building science were new to many, the level of interest and quick uptake on the core principles rivalled similar events I participated in in much colder regions, although probably the most frequent question was: "can I still open my window?"

Elrond Burrell, a New Zealander currently based in England and a prominent passive house blogger, walked the audience through the many beautiful passive house school projects by his firm Architype and showed some of the secrets to their success, such as simplified shapes and creative ventilation strategies. Raphael Vibert of Herz-Lang GmbH came armed with dozens of projects from all over the world, and with his vibrant presentation style demonstrated how passive house works at large scales. Meanwhile, I took the opportunity to show how passive house has come out of the box and become a contributor to global contemporary architecture from the humble beginnings of a central European vernacular.

Melbourne is personally my favourite city for developing extraordinary, environmentally challenging buildings, and with the great local talent and energy there we may soon see some of the most intriguing passive houses in the world come from down under.

Andrew Michler, CPHC, designed and built the first internationally certified passive house in Colorado and recently released the book '[ours] Hyperlocalization of Architecture''. It includes the chapter 'Germany Maintains on Passive House', which is free to download at www.hyperlocalarch.com.

News

Keystone: lintels key to tackling thermal bridging

Lintels may be the most important thermal bridge to tackle in a building, a leading lintel supplier has claimed.

According to Keystone Lintels Ltd: "Lintels are in most cases the most significant non-repeat thermal bridge in a dwelling, as traditional style cavity wall lintels interrupt the line of insulation with a continuous piece of highly conductive steel. The default or accredited Psi-value for a typical steel lintel is between 0.3 W/mK and 0.5 W/mK thus accounting for more than a third of the total heat loss through non repeating thermal bridges [in a typical case]."

The company said the award-winning Keystone Hi-therm lintel virtually eliminates thermal bridging across the lintel. The Hi-therm lintel utilizes a two piece construction, with a galvanized steel component supporting the inner blockwork connected to a GRP component supporting the outer brickwork. The GRP component has much lower thermal conductivity therefore reducing total heat loss substantially, resulting with a very low Psi-value of 0.05W/m.K or lower depending on block/ insulation conductivities. The Hi-therm lintel can provide in excess of an 80% improvement over the default or accredited lintel Psi-value, offering a significant advantage within Sap or Deap calculations.

Thermal bridging is factored into building regulations compliance in both the UK and Ireland, with the industry given various options, such as the use of punitive default values or inputting calculated values. A common alternative to using default values is to source calculated psi-values created by a person with suitable experience and expertise or a third party accredited assessor. Many leading building product suppliers such as Keystone Lintels now produce these bespoke Psi-values for their customers at no charge. The accredited assessor will use specialist thermal modelling software to draw the construction detail in the software package and then add in the material conductivities. This software then calculates the heat loss at the junction, subsequently producing an accurate Psi-value. The bespoke Psi-value can often be significantly better than the default or accredited value, thus having a dramatic improvement within the SAP/ Deap calculations.

(Above left) The Keystone Hi-therm lintel can achieve over an 80% improvement relative to default Psi-values, leading to significant calculated energy savings

Build airtight to protect your building's structure — Encraft

Building airtight isn't just about reducing energy demand, but more importantly, it's about protecting the fabric of your building, leading passive house and building physics consultancy Encraft has advised.

"The primary reason for requiring airtightness in buildings has nothing to do with energy efficiency or occupant comfort. In fact it is for the protection of the building fabric," Helen Brown, head of building physics at Encraft, has written in a blog post on airtightness published at www.passivehouseplus.co.uk. "Indoor air is more humid than outside air, and in a cold climate, indoor air is cooled as it flows out through the building fabric."

She continues: "As it cools, condensation will occur at a certain place within the construction and this may lead to serious damage to the building fabric. Air and wind tightness keeps your building healthy by preventing the flow of air through the fabric. Just a 1mm gap in the air barrier can transmit 360ml of water per day into the construction."

She says that without moisture problems, building components can theoretically last forever, and adds that airtightness is important for occupant comfort too. "Airtightness is relevant for occupant comfort through the elimination of cold draughts. It is ideally combined with mechanical heat recovery ventilation to always ensure superior indoor air quality. But it is possible to have a naturally ventilated building which is also airtight – the occupants just need to remember to open their windows or operate vents at the appropriate times to suit their needs."

"Testing for compliance should be carried out as close to practical completion as possible. This is so that the building can be tested in its in-use condition," she writes. "Site teams would do well to consider the use of leakchecker fans. These can be uncalibrated fans which aren't designed to give a test result, but do enable a comprehensive search for leaks which can be easily detected using smoke pens when a building is depressurised. Leakchecker fans can be hired but purchase may be more cost effective for large projects."

To read the full blog post, visit www.passivehouseplus.co.uk

(Below) Encraft's head of building physics Helen Brown, pictured speaking at the 2014 UK Passivhaus Conference

News

AECB launches online retrofit course

The AECB was pleased to welcome the first cohort of 42 students to its new on-line CarbonLite retrofit (CLR) course in April.

The course has taken around three years to prepare and brings together a wealth of knowledge on low energy building retrofit, including drawing on Enerphit experience, making it the first advanced retrofit course of this type in the UK. It provides the tools to understand how buildings interact with moisture and energy, and what makes for a comfortable and healthy environment.

The course is aimed principally at UK construction professionals and those whose role involves decision-making around retrofit. The students will work through eight on-line modules allowing them to fit the learning around their work or other commitments. At the end of each module, they will complete an online quiz and also submit a mini-assignment. This will be followed by a webinar discussion with course tutors. At the end of the course, students will gain the right to self-certify projects under the CL self-certification scheme (launching summer 2016).

Students are taking the opportunity to discuss topics on a designated forum with input from tutors, and feedback has been very positive so far. The next course will start in October 2016. Course content includes the direct and indirect benefits of robust retrofit; climate zones, local micro-climates and impact of changing weather patterns; understanding existing building structures and materials; energy and buildings; moisture and buildings; case studies; building services, including ventilation and heat; and financial appraisal, asking the key question: is retrofit a good investment?

AECB CEO Andy Simmonds – also of Simmonds Mills Architects – who initiated the CarbonLite retrofit programme, gives some insight into the case study content on the CLR course.

One project we cover is a Simmonds Mills retrofit – near AECB Silver standard – of a semi-detached pre 1919 rural cottage. The project uses a mixture of external, cavity wall and internal insulation. The wall facing the road, which faces west and has good exposure to the sun, was internally insulated. Sensors are embedded in wooden blocks in the wall at the masonry insulation interface to see what the temperature, relative humidity (RH) and timber moisture are over time. Half the elevation is treated with a microporous brick cream, and half not. Wufi modelling suggested that in this climate with a brick cream, vapour open, airtight, but non capillary active insulation, and variable vapour resistance airtightness and vapour control membrane the assembly – with a U-value of 0.22 – should work, with the wall drying down and reaching a safe condition fairly quickly.

We have circa three years of data, which suggests that the brick cream has indeed helped reduce RH at the interface, and also therefore moisture contents, allowing a lower U-value than normally recommended. Solar radiation means interface temperatures are also higher than predicted by the Glaser method: no interstitial condensation occurred in the monitoring period. The AECB has many case studies looking at wall and floor assemblies, including those using capillary active insulations, post retrofit and has developed a consistent method for data analysis including rot and mould growth risks over time. It can identify the different patterns relating to rain ingress, water vapour diffusion flows and adsorption of atmospheric moisture by materials at critical positions in the assembly. These case studies act to both inform the CLR course material and to further explore and illustrate building physics in the context of retrofit.

Another project – a wood fibre internal insulation case study – had a substandard outshot extension demolished as it was too expensive to upgrade, which was rebuilt in timber frame to passive house levels of construction, the rest of the house being insulated internally. The house also has whole house MEV rather than MVHR due to space and cost limitations. The RH and CO_2 levels of bedrooms and kitchen have been monitored to judge its effectiveness. The clients report no thermal discomfort, no noise problems and RH and CO_2 are good. Real life projects like this also provide illustrated detail of actual retrofit measures.

In this project a timber suspended floor was replaced with a thin concrete floor over a basement, with wood fibre floor insulation meeting the wood fibre internal insulation. Residual rising damp was anticipated following injected DPC work – as no injected DPC is perfect – and so the DPC was overlapped by a vertical DPM, before adding internal insulation. The parging layer behind the insulation is the primary airtightness layer, the brick walls had Safeguard Stormdry microporous brick cream, and the assembly is designed to minimise rain and rising damp loads, allowing the internal insulation to deal with only interstitial condensation loads. The monitoring has identified and provides examples of capillary bypasses to the neighbour at party wall and via an attached garden wall.

All of this feeds into the course and as more case studies become available more material can be added.

For more information about the AECB CarbonLite retrofit course visit www.aecb.net.

(Above) Case studies included in the CLR course get technical. Sensors in wood blocks measure RH, temperature & wood moisture content over time; a house retrofitted with wood fibre internal insulation and extended to passive house fabric levels

Insulation material choice key for thermal comfort — Ecomerchant

Leading sustainable building material supplier Ecomerchant recommends that anyone choosing insulation materials consider the ability of the material to prevent overheating and smooth out internal temperatures in their building.

To illustrate the point, the company describes two buildings on a hot day: one is a caravan, the other a stone-build house.

"In the caravan, as soon as the outside cladding starts to warm up, heat output is recorded within minutes on the inside face as heat quickly transfers through the aluminium and lightweight insulation composite," said Ecomerchant's Will Kirkman. "As the face of the stone wall heats up the heat progresses much more slowly from the outside to the inside."

The interesting, and often baffling, aspect of this phenomenon, argues Kirkman, is that the two materials can have very similar U-values, so that in steady-state conditions where heat is applied at a constant rate over a period of time to the external face of both materials, there is an equally constant flow from the inside surfaces of diminished heat.

"What's different about the caravan and stone house example is that the heating is not steady-state: real life heating from the sun varies throughout the day," he said. "This variability is known as periodic heat flow, and fortunately for the purposes of building design, it is almost entirely predictable.

It doesn't take much to rapidly heat a building through a lightweight structure such as a roof. Pitched roofs are efficient solar collectors and large in area compared to the internal volume of the internal space. Vaulted ceilings and rooms in the roof are often the hottest areas within a building. Timber roofs are lightweight with low thermal storage capacity, so heat from the sun will quickly transfer into space below, just like in the caravan.

"So we end up with bedrooms and living spaces that get too hot and create uncomfortable sleeping conditions," said Kirkman. "By the time we find this out it's normally too late. The key here is density, because mass acts as a heat buffer, and this leads to a phase shift, the time span between the highest external temperature and the highest internal temperature." The aim, Kirkman explains, is to delay the heat transfer through the fabric of the building so that high external temperatures only reach the internal side when it is already cooler outside.

"A proven answer to the problem is to use wood fibreboard insulation materials with high levels of diffusivity, meaning performance can be more closely mapped to traditional masonry construction, thus moderating internal temperature through the materials," he said.

Technopor all-in-one insulating floor slab

Ecomerchant is also the longest-established supplier of the all-in-one insulating floor slab material Technopor. Technopor is a pumice-like material made from 100% recycled glass — glass that would otherwise go to landfill — and is used to form an insulating solid floor slab as an alternative to concrete and foam insulation. "It is clean to handle, lightweight and exceptionally strong," Kirkman said. "When locked in place, en masse, as a solid floor slab, Technopor has remarkable technical credentials."

With a certified compressive strength of 0.5N/mm² it can carry loads of 50 tonnes per square metre. The closed cell structure of the granules prevents moisture being drawn up by capillary action into the building structure. It is frost resistant, and has class-leading Euroclass A1 certification for fireproofing. Floor screeds can be cast directly onto the compacted sub-base.
But, perhaps most importantly of all, with a lambda value of 0.08 W/m^{2}K, it can deliver passive house standards of insulation (the U-value required determines the depth of Technopor used).

"Independent evaluation of installation costs show that using Technopor to form a solid floor slab is up to 24% cheaper than traditional hard-core, concrete and foam insulation and 3% cheaper than beam and block," Kirkman said. "Technopor can be be laid in any weather conditions and requires no matrix or curing time; it is extremely quick to install."

Technopor foam glass aggregate is LABC approved and certified as a load-bearing and insulating building material by the German construction authority, DIBt, and carries the CE conformity mark enabling it to be sold throughout the UK. A range of sectional construction drawings are available for most applications.

To read more on Technopor and view the Steico range of wood fibre insulating boards and batts please visit www.ecomechant.co.uk. You can also download the Steico heat protection brochure from http://tinyurl.com/h4wte2y

(Above) Steico wood fibre insulation and Technopor foam glass aggregate, available in the UK via Ecomerchant

Building? Upgrading?

Passive House Plus is here to help!

Are you designing, building or pricing a sustainable building? Whether it's an energy upgrade of a small house, or you're looking to achieve high green standards with a new home, office or factory, Passive House Plus can help.

Fill in your details below, or online at www.passivehouseplus.ie & your enquiry will be sent to the Passive House Plus advertisers that provide the products or services you need. If you fill out your postal address we'll even send you the next issue of Passive House Plus free of charge!

PLEASE POST TO TEMPLE MEDIA LTD., PO BOX 9688, BLACKROCK, CO. DUBLIN, IRELAND

name: ______________________

profession: ______________________

company: ______________________

address: ______________________

____

phone: ______________________

email: ______________________

Site location (please list county): ______________________

Project type (tick box)

New home ☐ Home renovation/upgrade/extension ☐ New commercial/public building ☐ Upgrade/extension to a commercial/public building ☐

Other (please state): ______________________

Floor area (approx. ft² or m²): ______________________

Budget (approximate): ______________________

Stage (tick box)

Initial appraisal ☐ Pre planning ☐ Planning approved ☐ Pre tender ☐ Commencement notice ☐

Project imperatives (tick box)

Certified passive ☐ Near passive/low energy ☐ Indoor air quality ☐ Low running costs ☐Low environmental impact ☐

Other (please state): ______________________

Estimated start date (please state): ______________________

Just tick the products/ services you would like more information on:

- Airtightness & draught-proofing products ☐
- Building contractors ☐
- Airtightness testing & consultancy ☐
- Architects & designers ☐
- Cavity wall ties ☐
- Cladding & renders ☐
- Cross-laminated timber ☐
- Demand-controlled ventilation ☐
- Energy consultants ☐
- Energy upgrade contractors ☐
- External insulation ☐
- Green cements & screeds ☐
- Healthy building materials ☐
- Heat pumps ☐
- Heat recovery ventilation ☐
- Insulated basement systems ☐
- Insulated foundations ☐
- Insulation ☐
- Lintels ☐
- Passive house & low energy build systems ☐
- Passive house building contractors ☐
- Passive house consultants & designers ☐
- Radiant heating & cooling ☐
- Solar photovoltaic ☐
- Solar thermal ☐
- Sustainable mortgages / ethical finance ☐
- Sustainably sourced timber & wood products ☐
- Thermal breaks ☐
- Thermal building blocks ☐
- Timber frame ☐
- Windows, doors & roof lights ☐
- Wood fibre boards ☐
- Wood fuel / biomass stoves & boilers ☐
- Wood panel products ☐

I would like my project to be considered for feature in Passive House Plus (tick box) ☐


WINNER
GREEN AWARDS 2013
The Green Product Award
phA
CERTIFIED COMPONENT
Passive House Institute

Are social housing retrofit efforts failed by finance models?

Roughly 50,000 excess winter deaths occur annually between the UK and Ireland, with fuel poverty a primary cause. Yet although concerted social housing retrofit efforts could help tackle climate change while preventing thousands of senseless deaths of vulnerable people, flawed financial modelling is letting us down, argues Peter Rickaby.

For many years there has been a view that improving the energy efficiency of Britain's housing stock should be led by social housing. In 1994 the Department of the Environment's guide Energy Efficiency in Council Housing suggested that housing organisations should know the energy ratings of their dwellings and integrate energy work into their housing improvement activity. More recently, Margaret Beckett, then a housing minister, repeated the mantra that social housing should lead on energy efficiency, and for a while the Housing Corporation required housing associations to develop and implement sustainability strategies. Why has so little progress been made?

Much has changed. By 2004, after years of under-investment, social housing had an unsustainable £19 billion backlog of repairs. Consequently the Decent Homes programme was imposed: it repaired roofs and provided new kitchens but paid lip service to energy efficiency. In parallel large scale voluntary transfers and the establishment of tenant management organisations and arm's length management organisations opened more flexible funding options and took some housing investment off the public balance sheet. The industry rose to the challenge, restructured, refinanced and delivered Decent Homes.

Unfortunately the end of the Decent Homes programme coincided with new political initiatives: consolidation of housing organisations into groups, deregulation, privatisation, rent reduction and the right-to-buy. Asset managers emerged from the Decent Homes tunnel, blinking in the sunlight, into a landscape from which someone had taken away the tracks. Other than the fuel poverty regulations there is little guidance about what they are expected to do about energy efficiency.

Against this backdrop the Homes and Communities Agency promotes a corporate approach, encouraging housing organisations to behave like commercial property companies. In response, consultants have developed financial models that use elemental data (about roofs, kitchen fittings, etc.) from sample stock condition surveys: they estimate the life of each element and calculate the necessary investments in repairs and replacements. The models compare the required investments with rental income and calculate each dwelling's 'net present value'. Dwellings with negative NPVs are deemed uneconomic and earmarked for disposal. Many housing organisations now use such models.

There are three problems with this approach. The first is that it encourages disposal of the least energy efficient homes – the ones that require the most investment. This is passing the buck: those homes will be sold to private sector landlords or tenants who are less willing or able to invest in energy efficiency. It would be more appropriate to demolish them and redevelop the sites with new homes built to the passive house standard.

The second problem is that energy efficiency is expensive. The cost of improving a typical housing stock to a realistic affordable warmth standard (e.g. SAP 80) or an appropriate environmental standard (e.g. 50% reduction in emissions) is eye-watering. When this cost is included in the financial model the level of investment required causes all the NPVs to go negative. Consequently fuel poverty and climate change have become like two elephants in the room – they are ignored because the challenge is too big. As a housing director recently remarked "We will improve energy efficiency when we are told or paid to do it".

The third problem is that the financial models do not include tenants' fuel costs, even though they are a significant and growing proportion of housing costs. If tenants' fuel costs were included in the models the NPVs would still be negative, but at least investment in energy efficiency would improve them. The nub of the problem is that commercial asset management models are inappropriate to social housing. Public housing is not a commercial investment, it has a social purpose: to provide affordable homes for poor people. Most social housing organisations acknowledge that delivering affordable warmth is a key element of affordable housing (given that rents are subsidised by benefits but fuel costs are not), but they do not seem to realise that their financial models are not fit for purpose.

Housing consultants are aware of this problem but many seem unwilling to address it. One suggested that energy ratings could be used in the models as evidence for marginal reductions in the estimated costs of complaints, repairs and void properties. This is a pathetic response – what is the point of a model that ignores not only key challenges for the sector but also key stakeholders and their costs?

There is cause for optimism. Some asset managers have realised that if they don't rise to the twin challenges of fuel poverty and climate change, and provide leadership, then nobody else will. The National Housing Maintenance Forum has recently published online best practice guidance on fuel saving improvements. Some housing associations have integrated energy efficiency into their strategies, and for some fuel poverty is now a key driver of investment. However, there is still a long way to go.

Peter Rickaby is Director of Rickaby Thompson Associates Energy + Sustainability Consultants, a member of the Board of Trustees of the National Energy Foundation (NEF) and a corresponding member of the RIBA Sustainable Futures Group. The views expressed in this article are his own and do not necessarily reflect the views of the NEF or the RIBA.

"Commercial asset management models are inappropriate to social housing. Public housing is not a commercial investment, it has a social purpose, to provide affordable homes for poor people."

One family's passive journey

One young Irish family has taken the decision to build their new home in Co Louth to the passive house standard. In the first of a series of columns, Nessa Duggan explains the thinking behind the decision to go passive.

I grew up in a large, draughty, listed building and I am never going back to that scenario. Cornicing, parquet floors and original fireplaces are all well and good but they don't pay the heating bills. So one lovely husband and three adorable kids later my current home is just the opposite: really easy and inexpensive to heat, just the way I like it. If only it were big enough to accommodate our boisterous brood we would probably never leave.

We bought our current home during the boom, not really thinking it would be where we would raise our family. Three sons later, we needed more space and a bigger garden, but were determined not to settle for a house that didn't tick all the boxes.

With a personal interest in the environment and energy efficiency, we made some improvements, closed in the open fire and installed a stove, added extra insulation and upgraded the heating controls. We enjoyed a decent size south-facing kitchen-diner and our little garden was a sun trap. All these added up to a very cosy home and a standard of comfort we were not willing to forsake for more space or a bigger garden.

For over two years we viewed every potentially suitable house on the market. None ticked all the boxes and without exception, none would have been as comfortable as our home without a major renovation that would blow our budget. With draughty windows and boilers from the 1970s, we couldn't be tempted to move.

We always wanted to build our own home, with romantic notions of mature fruit trees and a vegetable patch, but didn't think it was realistic in the area where we settled. Then, a site came on the market that could potentially tick all the boxes. It was close to the school, south-facing back garden, mature fruit trees, and gave us the opportunity to design a house for our specific needs and a high level of energy efficiency – it was too good to be true. We put an offer on the site that was accepted and paid a deposit within days, with only a vague notion of what to do next.

The sale dragged out, as they do, and we set about researching the next steps. We were aware of the significant improvements in Part L of the building regulations (dealing with conservation of fuel and energy for dwellings) and spoke to friends, and friends of friends or anyone willing to chat about their self-build experiences.

Luckily for us, we found lots of people more than happy to share their experiences. Many were passionate about the various technologies installed in their homes. Without exception, it seems the changes to Part L had a dramatic impact on the cost of heating new homes. Stories of not turning on heating systems for 11 months of the year are undoubtedly welcome and directly attributable to the new Part L changes. But more than once, instances of overheating in some houses made them uncomfortable and measures had to be taken to counteract the excess heat. Stifling heat from solar gain causing windows to be left open all the time – who would have thought this would happen in Ireland?

Some years previously, we visited the Scandinavian Homes passive house in Moycullen, Co. Galway. What struck me that day stayed with me, it is hard to put a finger on, but there was a feeling of freshness in the air and a peaceful silence. More recently, we visited a local new build, during the NZEB Open Doors weekend, and once again were struck by a serene feeling. The comfort of the even, ambient temperature and the silence of an airtight house close to a busy motorway is hard to describe.

This brought us to research the passive house standard for our project. The idea of a cosy ambient temperature 24/7 sounded like a little piece of paradise. Of the several passive home owners we spoke to, the only regret that cropped up was not having factored a second fridge into the kitchen design – because all perishable food has a much shorter shelf life when the temperature in every corner of the house doesn't stray far from 20C, 24/7. What we heard over and again was that careful planning and integration of passive design principles into the design from the outset was key to success.

'Nearly passive' to us meant a risk of overheating. As a techie couple, the idea of engineering an equilibrium into the design and operation of the house to create this ambient atmosphere clicked very quickly. The more we read, the more convinced we were, that we should attempt to achieve passive certification for our new build. *To be continued in the next issue.*

"We always wanted to build our own home, with romantic notions of mature fruit trees and a vegetable patch, but didn't think it was realistic in the area where we settled."

With political will, we can decarbonise the grid.

The UK can design and build the energy infrastructure needed to support progress towards a decarbonised nation, if there is sufficient political will, writes leading sustainable energy consultant Andy Hamilton.

The article ‘Zero energy, zero sense?’ by David Oliver in issue 15 of Passive House Plus starts by stating that new dwellings in the EU should be “nearly zero energy” from 2021. The author then notes the EU’s “decision to mandate” and makes the assumption that on-site generation electricity required will be provided by rooftop solar PV arrays. The author says a flaw in this directive is that it fails to address “limited network capacity”.

The assertions and assumptions in the original article are examined here in terms of EU policy and UK network capacity. Note that there is a detailed and informative discussion of EU policy on nearly zero energy buildings (nZEBs) and its implications for building design in the article ‘Passive house or equivalent?’ by Jeff Colley in the same issue of the magazine, so this response will just consider the policy details of the relevant EU directive, and their implications for electricity grids.

To do this, a review of the text of the EU directive in question is necessary. The Energy Performance of Buildings Directive 2010 is a “recast” (rewrite with extensive amendments) of the 2002 policy. It should be noted that national governments are given discretion in the application of the policy which states that the, “performance of buildings should be calculated on the basis of a methodology, which may be differentiated at national and regional level”, and that it is “the sole responsibility of Member States to set minimum requirements”. The recast EPBD reflects a move towards discretionary EU legislation in response to national demands. This discretionary approach has led to some governments adopting a low level minimum.

In the UK the Energy Efficiency Deployment Office and other energy saving initiatives were terminated following the formation of a new government in 2015. The UK is now rated 27th out of the 28 EU countries by European Energy Efficiency Watch. As it is possible that Europe as a whole may fall short of the targeted 20% reduction in energy use by 2020, this autumn, scientists across Europe will work with the European Commission to examine ways to ensure better compliance with the recast EPBD by governments such as the UK.

The directive calls for the construction of nZEBs with local sourcing of the limited energy required by these buildings. The text states: “The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby”. What is meant by renewable sources nearby is left to national interpretation.

However some guidance is provided, with the directive stating that, “‘energy from renewable sources’ means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases”. This wording promotes a liberal interpretation of “nearby”.

It is up to national governments whether they want to promote use of solar PV or any other low carbon technologies. However any realistic government plan to increase electricity production from low carbon technologies will have to include plans for changes to the electricity transmission grid and energy storage facilities.

Currently the UK grid cannot accommodate the growth of renewable technologies. In 2007 it was noted that, with the growth of generation from renewables, “transmission and distribution congestion in the utility grid is growing with energy demand outpacing investment in new or improved transmission facilities” (Lasseter and Piage, 2007, quoted in Zero Carbon Britain 2030, CAT 2010).

Electricity in the UK is transmitted through two grid systems. The high voltage (typically above 200kV) national grid, and lower voltage local, or utility, grids. These lower voltage grids, which connect homes and businesses to the national grid, are run by 14 private sector distribution network operators (DNOs).

In 2015, Western Power Distribution, the DNO for the Midlands, south-west England and Wales, closed the grid to new large renewable projects in Cornwall, Devon, Somerset and Dorset for up to six years. In a market forces economy, upgrading the local grid can be unprofitable.

There are examples elsewhere of national and local grids being reconfigured to facilitate a low carbon future. The German government’s ‘Energiewende 50 80 90’ project (50% energy reduction, 80% of energy from renewables, resulting in a 90% $C0_2$ reduction) includes detailed consideration of electricity grids at national, regional and micro scales. The German ‘Kombikraftwerk’ projects demonstrate what is possible. Granted, Germany may have better grid interconnection than the UK given its location in continental Europe – although the UK has 4GW connections to France, Ireland & the Netherlands, with a further 7.3GW due to Belgium, Denmark, France, Ireland & Norway by 2022 – but the German plans rely mainly on domestic supply. These large projects, funded by the German government, and led by the Fraunhofer research institute and the heavy engineering company Siemens, have applied intelligent systems technologies in the two projects described below:

Kombikraftwerk 1 (2007 to 2010), the combined power plant: this project demonstrated that renewable power sources, in this case 36 wind, solar, biomass and hydro installations, can be operated as one virtual power station, as reliable and controllable as one large scale fossil fuel power station.

Kombikraftwerk 2 (2010 to 2013), reliable electricity grid operation with 100% renewables: the project ended with a field test which demonstrated that renewable generation, when scaled up, can supply all German electricity needs. It was noted that an aggregation of renewable generation plants controlled as an intelligent system “can react far faster than conventional power stations, … to better fulfil their system responsibilities”. The scenario assumes that the forecast electricity demand will be met with 60% wind energy, 20% photovoltaics and 10% bioenergy, and the remainder by geothermal energy and hydroelectric power, with some storage.

Currently about a third of German electricity supply is already generated by renewables, considerably more than in the UK, and the construction of the type of electricity grid envisaged in Kombikraftwerk 2 is well under way. The UK can design and build the energy infrastructure needed to support progress towards a decarbonised nation, if there is sufficient political will.

> “The UK is now rated 27th out of the 28 EU countries by European Energy Efficiency Watch.”

INTERNATIONAL SELECTION

This issue’s selection of international passive buildings features stunning homes in Melbourne and Barcelona, and an architecturally jaw-dropping new community centre in the suburbs of Paris.

Photos: Adrià Goula

Casa LLP, Barcelona

This stunning passive house was designed by Alventosa Morell Architects following a request from his clients — two sisters — for a house in which they could live together, but at the same time be independent. So each sister has her own bedroom, living space, kitchen, studio and outdoor terrace, with each half of the house mirroring the other.

The architects aimed to make the building as comfortable as possible by focusing on four key elements: a compact shape, solar gain, super-insulation, and cross ventilation, the latter achieved after detailed study of the site's microclimate.

Because the design team didn't want to modify the plot, the cantilevered single-storey structure adapts to the sloping site, with two retaining walls supporting a lightweight timber frame, which is insulated with cellulose.

The fully glazed cantilevered façade faces south, looking out on the wooded Collserola Mountains, with a balcony stretching across the length of the house here too. And with space heating demand of just 9 kWh/m^2 per year, the house is well inside the passive house standard. There's also a special observation deck with clerestory windows on the green roof — for looking out on the mountains, or up at the night sky. ▶

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings and stunning photos we had to omit rom the magazine.

The digital magazine is available to subscribers on www.passive.ie


JOHN
IRVING

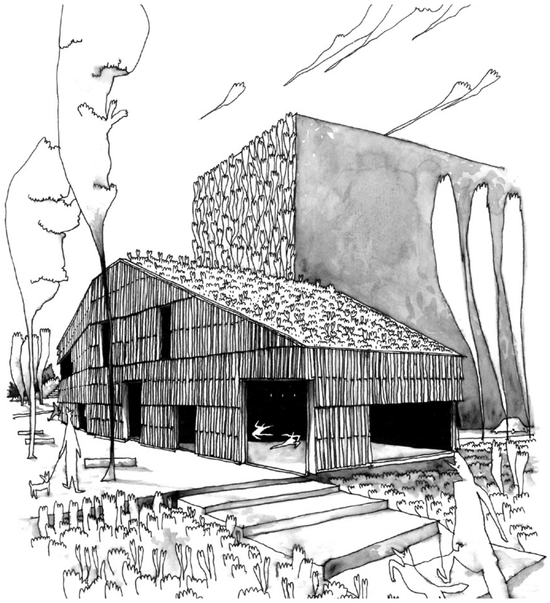
Christian Marin Community Centre, Paris

This new timber-framed community centre forms a central part of the regeneration of Limeil-Brévannes in south-east Paris, which includes the new Pasteur eco-district and the renovation of the Saint Martin neighbourhood, featuring 700 new housing units.

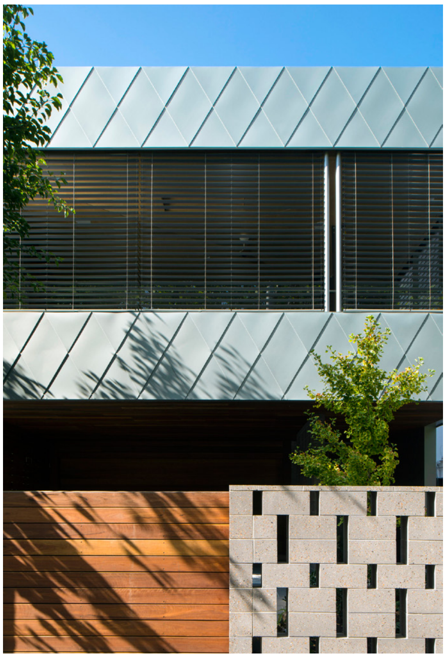
Coming from Paris city centre, this new landmark building provides the first glimpse of Saint Martin, “a clear sign of the district’s engagement to renovate and revalue itself,” according to architect Guillaume Ramillien. The building — located at the entrance to a public park and set against the windowless gable of an apartment block — expands from a single-storey at its front to a two-storey building at the rear.

Inside, the building features four large rooms for community use, connected by a central atrium. Meanwhile, “the outside appearance is reminiscent of a textile pattern,” according to Ramillien, “thanks to the use of two different woods as well as a shading effect with light reflecting on each wood panel.”

The centre is designed to introduce a warmer, more human architecture to the district: it features a green roof that will develop into a wildflower meadow, while the choice of larch and fir cladding contrast with the typical architectural design of the surrounding apartment blocks. And with space heating under 15kWh/m^2 per year, it meets the passive house standard too. ▶



Photos: Pascal Amoyel / Guillaume Ramillien Architecture



Photos: Richard Glover

Emerald House, Melbourne

This residential street in the suburbs of Melbourne features several buildings with heritage significance — an architectural time-capsule of late 18th century homes. The owner of this new passive house — dubbed Emerald House — originally wanted to refurbish the existing home on the site, but according to architect Fiona Winzar, that dwelling had already been "botched with a poor make-over leaving it with no heritage value."

So Winzar designed a brand new passive house, creating a 21st century addition to the street, built with a combination of timber frame and cavity wall construction. Key elements such as the customised diamond zinc façade make reference to St Thomas Aquinas Church close by, while the use of natural white render and linear windows reference nearby art deco apartments.

Living spaces face north to optimise solar gain (this is the southern hemisphere remember), while there's also solar PV and a solar thermal system with a massive 22,000 litre tank that heats an underfloor system, a spa, and a swimming pool.

The dwelling has an S-shaped form stretched over the length of the site to bring garden and light into the centre of the house. The S form divides the front of the house, for living, from the back, for sleeping.

"The main challenge was finding a building team and contractors who could deliver the performance requirements involved in German passive house technology," says Winzar. "Airtightness, high-performance insulation and fresh air ducting are relatively new in Australian architecture practice and generally involve imported products.

"The building form is quite complex and together with these new technologies Ducon's [the contractor's] site supervisor was required to be super attentive to co-ordinate his trades. The supervisor had to train all of the trades in airtightness practice and awareness so that air leakage could be minimised," Winzar says.

Compact solid-timber **passive house** *on London infill site*

Photos: Alex Sargison/Adrian Wolfson

Built from a simple palette of timber and concrete, this diminutive but architecturally unique home managed to meet the passive house standard despite a small and awkward site.

Words: John Cradden

Building a new home in the tight confines of someone's backyard brings its own set of challenges but, given the value of property in London, it's a popular type of development and architects with skin in the 'urban infill' game have all sorts of tricks up their sleeve to make the most of the available light and space.

When Bernard Tulkens of East London-based Tectonics Architects, which specialises in residential projects, decided to design and construct a new dwelling in the back garden of his home in Hackney, he also elected to build to the passive house standard. The result is a highly discrete 94 square metre two-storey detached house set half a level down from the street (as per local planning rules), with the lower level built in reinforced concrete, and a prefabricated upper level structure made from cross-laminated timber (CLT). A small gate opens onto a paved area, where there is a view of the garden, and a few steps leading down to the front door on the ground floor.

Inside, the bedrooms are on the lower ground floor and the upper level has an open plan living space with kitchen. It's bright and airy — the first impression is that it aims to be minimalist, but that wasn't Bernard's intention. "I like simple use of materials, and in this case it was possible and relevant to keep the construction visible [via the exposed timber and concrete inside]. It does not feel minimalist as the materials are very much present, with concrete at lower ground floor and timber above.

"I was interested in creating a nice space with a limited palette of materials. In terms of space I wanted to create a house that is flexible, with an open plan upper ground, a kind of 'piano nobile'. I also thought it was a chance, as an owner and architect, for me to have a clear and measurable energy and sustainability standard." He was particularly keen to use CLT and natural insulation in the form of wood fibre.

Designing a passive house in such a location shouldn't, in theory, be a big issue. But the site, which had been extended by the previous owner to include two plots that linked it to the street behind his own home, had the distinct problem of being strongly overshadowed by a terrace of tall Victorian houses.

Indeed, one passive house designer Bernard spoke to early on indicated it would be a tough site to meet the passive house standard on. But while acknowledging the challenges posed by the site, it clearly didn't phase the designer who ultimately took on the project, Peter Ranken of Accredited Passivhaus Design. He helped persuade Bernard to build to the standard after meeting him at the 2013 Ecobuild show in London. "When I saw the plans I liked the design, and thought the house had a good straightforward shape, suitable for passive house," Bernard says.

The overshadowing issue stems from the convention that passive buildings rely a good bit on the heat gain from south-facing windows to achieve the annual heating demand target of 15 kWh/m^2 per year. Bernard's house has only one south-facing window, which in turn is at the lower ground floor level where it receives no direct sunlight, while the east-facing windows were partly overshadowed by a street tree (since heavily pruned by the local authority). ▶


ecoHaus Internorm
INTERNORM'S MOST COMPETITIVE GUARANTEED
NEW HF410 OAK Composite PASSIVHAUS WINDOW
• U-Value as low as 0.70W/m2k
• 7 Oak or Ash Internal Finishes
• Patented iCore Technology
• Sound Reduction up to 46dB
• 4 Aluminium Clad Design Styles
• Only 9% uplift on Softwood
INTERNORM'S NO1 UK PARTNER 2013-2015
SALES, SURVEY & INSTALLATION – NATIONWIDE
tel: 0800 612 6519
web: www.ecohausinternorm.com
email: sales@ecohausinternorm.com

"The major source of solar heat gain is the west-facing windows, and therefore [the house is] more prone to evening overheating," says Peter. "So it was a balancing act to achieve sufficient solar gains in winter whilst preventing overheating in summer." Part of the strategy was to include enough insulation to retain the limited heat gains that were available. As well as the 300mm of Isoquick load-bearing polystyrene under the floor slab, the team added extra insulation above the slab under a layer of polished concrete as the internal finish.

At one point, railings outside the windows added too much heat loss through their fixings, and overshadowed the west facing windows, so they were designed out and the windows revised, according to Peter. "There was also a delicate moment when I had to suggest to Bernard that a north-facing window giving a view of a favourite flowering camellia would need to be omitted," he adds.

Bernard concedes the house is better without that window, and adds that during the design process they cut down on the number of openings at lower ground floor. "I had more windows as I wanted to make the lower ground floor feel open, connected to the garden and bright — but it feels still very glazed and open. Bedrooms do need walls somehow, and even in the study it feels right as it is."

To maximise the winter heat gains, the glass in the west facing windows was changed to a less insulating type with a higher g factor to increase heat gains. Bernard was also keen to create a purely electric house but the shadows from the tall Victorian terraced houses ruled out the use of solar hot water panels or photovoltaics as part of the initial specifications. "I will put some PV in, but they are not part of the basic passive house design," he says.

The lack of solar gains from the south also necessitated a highly efficient MVHR unit — a Paul Novus 300 unit that was supplied by Total Home Environment, and which required careful installation. "I was concerned about the noise of the system but that proved not to be an issue at all. It is very quiet, we can't hear it at all," says Bernard.

Although he did not intend to be the main contractor, the number of specialist sub-contractors involved (for the CLT, wood fibre and taping, MVHR, roof, zinc etc) and their respective costs prompted Bernard to take on this role. Being the client, architect and project manager was a "big enough task" but, as this was his first passive house project, Peter Ranken's input was essential, "not only to have the calculations done independently but also an exchange of ideas and a dialogue about the project".

The prefabricated CLT for the upper floor was supplied and fitted by London-based firm Eurban. What was the appeal of using CLT? "Cross-laminated timber was interesting for me because is it a natural product, and allows for a breathable construction," says Bernard. In short, he says it's a more flexible way of prefabricating with fewer materials involved, and simple and controllable joints at the point of assembly.

"I was still free to use it in combination with any other building material, such as the wood fibre, the windows, the zinc etc. Having a single point of engineering, manufacturer and installer was

'I had to suggest to Bernard that a north-facing window giving a view of a favourite flowering camellia would need to be omitted'

also a good system for this building," he adds.

The large building elements involved also mean fewer joints, which means less likelihood of air leakage. "It provides continuous surfaces with little joints that can be left exposed if desired, which in the case of this simple building was ideal."

Peter adds: "Cross-laminated timber panels have few joints that could cause air leakage, and a continuous airtightness membrane on the outside of the panels prevented leakage through these."

The excellent airtightness score (0.29 air changes per hour) is surely testament to their attention to detail – and the involvement of one of Ireland's leading airtightness contractors, Clioma House. The house was air tested twice, and was well below the passive house requirement on both occasions, with the final test better than the first, according to Peter.

Although he didn't commission the building for himself or his family as it's quite small, his parents-in-law were looking to downsize and move to London and so asked if they could move in shortly before construction began. He didn't have to change too much for his in-laws — he upgraded some of the finishes like the kitchen, and bathroom, and installed more fitted joinery, Vitsoe shelving and curtains for the lower ground windows. He modified an opening to the second bedroom so that it is wider and more connected to the hallway.

"They like the space. It is full of light, feels spacious, peaceful and I think they like the exposed materials of wood and concrete," Bernard says. "It is also very comfortable from an acoustic and temperature point of view as well."

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

SELECTED PROJECT DETAILS:

Architect: Tectonics Architects
Passivhaus Design/PHPP: Accredited Passivhaus Design
Passivhaus Certifier: WARM
Structural engineers: Michael Hadi Associates
Cross-laminated timber engineers & contractors: Eurban
Sub floor insulation: Isoquick
Airtightness & wood fibre insulation contractor: Clioma House Ltd
Lower ground floor insulation & brick slips: Alsecco / Meti Building Services
Windows: Internorm UK
Zinc: Peters Roofing
MVHR: Paul, via Total Home Environment
Air testing: Jennings Aldas / Paul Jennings
Electrics / KNX installation: Sagar Smart Homes
Rigid insulations: Kingspan, Jablite
Wood fibre insulation / airtightness products: Ecological Building Systems
Gas boiler: Worcester Bosch ▶

(above) The upper level is constructed with cross-laminated timber panels, which is a more flexible way of prefabricating with fewer materials involved and allows for simple assembly. The large building elements involved also mean fewer joints, which means less likelihood of air leakage, improving the airtightness of the building

(above) The Isoquick insulated foundation system eliminates any thermal bridges between the floor and walls; (Top right) while the lower level is built in reinforced concrete, the cross-laminated timber panels are also used for partition walls; (Top left) excavation works were carried out and a retaining wall constructed as local planning rules required the house to be set half a level down from the street

PROJECT OVERVIEW

Building type: 94 sqm (treated floor area) detached house constructed with cross-laminated timber panels.

Completion date: April 2015

Budget: Confidential

Passive house certification: Certified

Space heating demand (PHPP): 13.64 kWh/m²/yr

Primary energy demand (PHPP): 99 kWh/m²/yr

Airtightness (@ 50 Pa): 0.29 air changes per hour

Measured energy consumption: Measuring in progress

Thermal bridging: Accepted as thermal bridge free by passive house certifier. All insulation is external to structure, including: insulated raft foundation, larsen type timber and plywood framing to support upper floor zinc cladding and parapet, adhesive fixed brick slips on external polystyrene insulation.

Ground floor (from inside): 75mm polished concrete, on 25mm Kingspan TF70 insulation, on 300mm reinforced concrete, on 300mm Isoquick expanded polystyrene insulation. **U-value:** 0.094 W/m²K

Lower retaining wall (from inside): 175mm reinforced concrete on 300mm Kingspan Styrozone H350R insulation. **U-value:** 0.101 W/m²K

Lower wall (from inside): 175mm reinforced concrete, on 250mm Jablite insulation, on 8mm render, on 15mm brick slips. **U-value:** 0.146 W/m²K

Pavement wall retaining (from inside): 13mm plaster, on 175mm reinforced concrete, on 250mm Kingspan Styrozone H350R insulation, on 215mm reinforced concrete. **U-value:** 0.119 W/m²K

Upper ground floor wall (from inside): 100mm Eurban cross-laminated timber, on Pro Clima DA breathable vapour control membrane, on 140mm Gutex Thermosafe Homogen wood fibre insulation, on 120mm Gutex Thermosafe Homogen wood fibre insulation, on 60mm Gutex Ultratherm wood fibre insulation, on 50mm air gap, on 12mm plywood, on Zinc cladding. **U-value:** 0.106 W/m²K

Roof: Single-ply membrane, on 240mm (average) Kingspan Thermataper TT47 insulation, on vapour control layer, on 160mm cross-laminated timber. **U-value:** 0.080 W/m²K

Windows: Internorm triple-glazed aluminium clad windows, argon fill. **Whole window U-values:** 0.70 to 0.89 W/m²K; higher g value in west-facing windows.

Heating system: Two electric heated towel rails in bathrooms – Bard & Brazier DRW 52-120 & 75-50. One electric connection heater in living room – Meinertz K60-123-12.

Hot water: Worcester Bosch Greenspring high efficiency condensing gas boiler

Ventilation: Paul Novus 300 heat recovery ventilation system, circular galvanised steel ductwork. As installed efficiency **(PHPP):** 90.9%

Green materials: Cross-laminated structural timber panels for upper floor external walls, roof, intermediate floor and lower floor partitions provide structure and internal finish. Wood fibre insulation to CLT panels. Osma wax finish to CLT panels internally (no internal wall linings).

“Even now relatively few contractors have had first hand experience of building to passive house.”

Photos: Image Quest Photography

Affordable scheme keeps up Hastoe passive *momentum*

The latest in a long line of affordable passive house schemes from trailblazing housing association Hastoe, this new development at Outwell, Norfolk features 15 brand new passive homes.

Words: Ben Adam-Smith

Norfolk-based housing association Hastoe has become one of the UK's leading passive house developers, with a string of affordable passive schemes under its belt, and with one of the latest being in the village of Outwell.

When the local district and parish councils identified a need for affordable housing here, they approached Hastoe about the possibility of developing a scheme in the village. After a housing needs survey backed up this case, a call for land identified several sites, and the community was engaged to see which option might be preferred.

Hastoe says no two of its schemes are the same and in part, that can be put down to embracing the local vernacular. However, as a ribbon village, Outwell was more of a challenge.

John Lefever, regional head of development at Hastoe Housing Association, says: "You couldn't put your finger on what made that village distinctive, unlike say Burnham Overy Staithe, where it's listed and there's a lot of flint and stone and we reflected that in the delivery there [of six passive house units]. So we had the opportunity here to do something slightly different, so we went with a more contemporary feel."

The district council had even requested that Hastoe build the 15 affordable homes — a mixture of flats and houses — to passive house standard after seeing progress on Hastoe's schemes at Burnham Overy Staithe. It was keen for this development to be of a similar quality. With Hastoe's commitment to deliver around 20% of their programme to passive house standard anyway, this became an easy choice.

John continues: "Our board is one that wanted to get residents out of fuel poverty and of course for us to deliver new affordable housing programmes. We have to charge what's called affordable rents, which are slightly higher than the old social rents. So our board took the view — is there any way we can offset this? And the obvious way forward is to deliver something that will ensure that their fuel costs are much lower than normal. And hence passive house."

Long-established architectural practice Ingleton Wood already had a working relationship with Hastoe, and was appointed to the project in August 2012. This gave the firm the opportunity to design their first passive house scheme.

Architect John Dixon explains: "We'd been looking at passive house as a concept for probably seven or eight years. And we'd been involved in a number of different schemes to, shall we say design stage… Particularly with housing associations is where the prior interest has come from. They're always the leading edge if you like, of trying to reduce energy costs for their tenants. But this is the first one that's actually made it all the way through the hurdles."

Following an appraisal of shortlisted sites, one just off the main thoroughfare was selected. Ingleton Wood's experience of delivering affordable housing was invaluable, but applying the additional layers of passive house design introduced some financial pressures.

David Thompson, senior architect at Ingleton Wood, says: "I guess the way we approached it was to keep it as simple as we can, use tried and tested products and materials, keep the building footprints as tight as they could be to meet the housing association requirements and not put lots of fancy bolt-ons on. That quite often has been a pitfall with affordable design — lots of sort of added-on bits. Well we tried to keep that to an absolute minimum as was required to achieve the passive house design."

Contractor EN Suiter & Sons came on board after winning the tender. The firm had the experience of their first passive house build at Burnham Overy Staithe, which was a traditional brick and block construction. At Outwell, a timber frame solution was chosen. With airtightness membranes on the inside, the build-up features Knauf Earthwool between the studs and Pavatherm wood fibre insulation external to the timber frame, with a cavity and brickwork skin outside this, though there is timber cladding in places too.

Quentin Mitchell of EN Suiter & Sons, highlights one of the challenges of this build method: "You are reliant more on the membrane remaining completely intact throughout the build process. At Burnham Overy Staithe it was a blockwork inner skin so the chances of puncturing a hole, however small, through a Thermalite lightweight block is very remote." Communicating this to the team on site helped them achieve the stringent passive house airtightness target.

David Thompson says: "Even now relatively few contractors have had first-hand experience of building to passive house and many of them don't fully understand all the rigours. But thankfully Suiters were absolutely up for working with us, and taking time to work through with us, to understand where all those potential constraints were and they managed to pull it off."

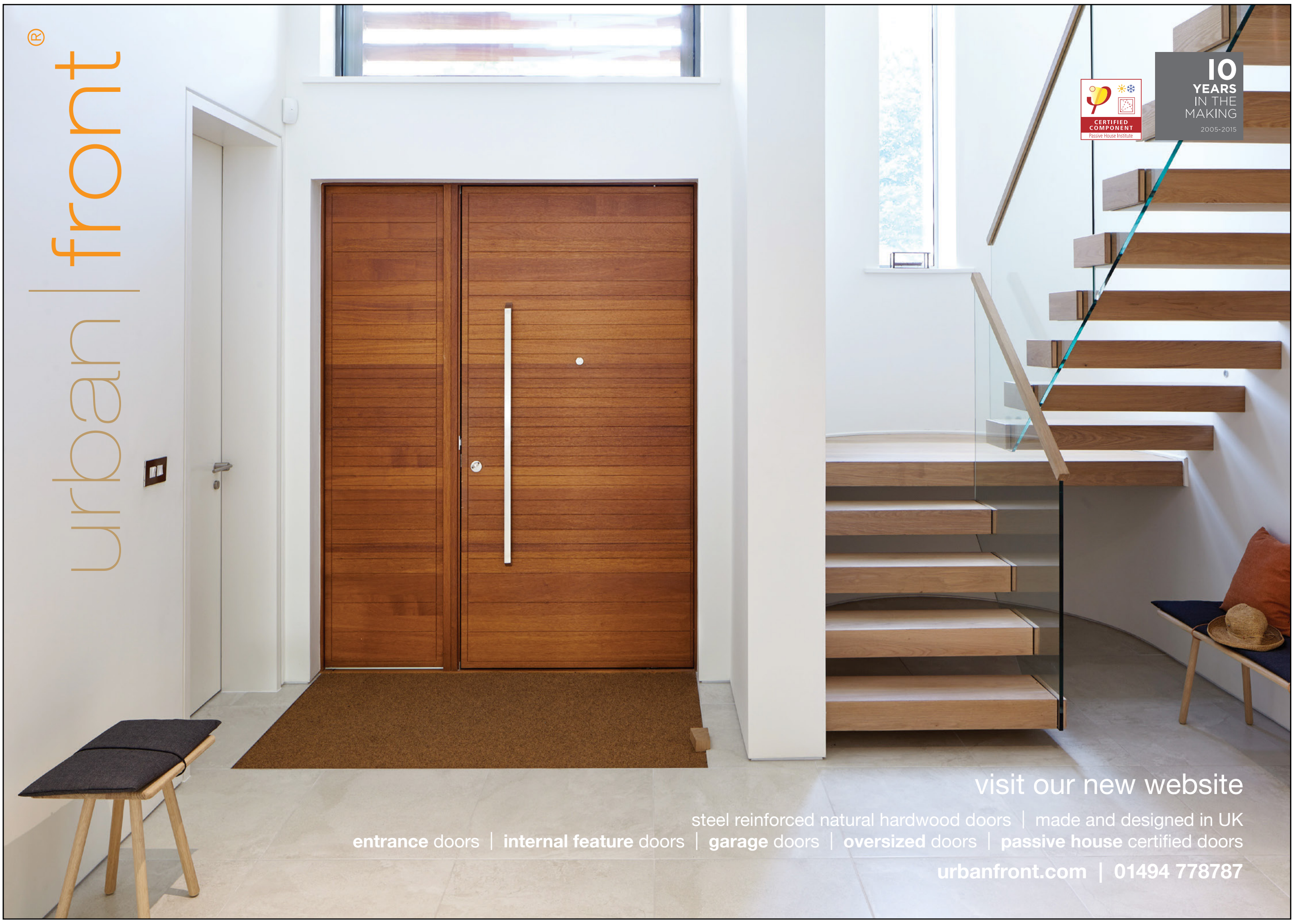
The scheme, which was completed in May 2015, has not undergone performance monitoring, but has been well received. This year it won the eco home prize at the Norwich and Norfolk Eco Awards. It was also nominated for King's Lynn and West Norfolk Mayor's Design Awards, having been put forward by the parish council.

Hastoe has now delivered or is currently on site with around 200 passive house homes, which includes some open market units. However the association still believes building to the standard costs somewhat of a premium (ed. – this observation is specific to England, where energy standards under building regulations are comparatively weak).

John Lefever comments: "We're a housing association. People think that we're not commercial but that's far from the truth. We have to be very commercial. We have to make sure that the finances stack up, the rental income has to cover the cost of the borrowings that we take on schemes."

The good news is that everything seems ▸

Will your perfect home be a Passivhaus?
You know that a Passivhaus home is energy efficient, comfortable, affordable to run – and delivers lower carbon emissions. We agree.
We've been building a greener society since 1981 and specialise in mortgages that support Passivhaus projects. All our lending decisions are based on environmental impact – and as we think outside of the box, we consider unusual or innovative construction types and materials.
If you are considering a Passivhaus build or an EnerPHit standard renovation, our friendly mortgage team would love to hear from you.
Ecology Building Society
01535 650 770
www.ecology.co.uk
YOUR HOME MAY BE REPOSSESSED IF YOU DO NOT KEEP UP REPAYMENTS ON YOUR MORTGAGE
Ecology Building Society, 7 Belton Road, Silsden, Keighley, West Yorkshire BD20 0EE



urban | front®
10 YEARS IN THE MAKING
2005-2015
CERTIFIED COMPONENT
visit our new website
steel reinforced natural hardwood doors | made and designed in UK
entrance doors | internal feature doors | garage doors | oversized doors | passive house certified doors
urbanfront.com | 01494 778787

to be moving in the right direction. As more and more passive house projects are completed, and contractors get more comfortable with the standard they are not pricing in risk as much, and the supply chain is growing too.

John continues: "When we started Wimbish [Hastoe's first passive scheme] I think there was only one or two window suppliers that could deliver the windows that are required to deliver a passive house scheme. Now there's something like 32 in the UK. So prices on components are coming down. We are finding that we're getting lower prices but we're still not at where we want to be."

Meanwhile John Dixon of Ingleton Wood says housing associations, such as Hastoe, are leading the way in terms of driving up quality — but he believes the private residential sector is showing few signs of wanting to follow suit yet.

He says: "We still see relatively little interest in the local area from private developers or large scale developers in doing a passive house development or anything like that. They are still bottom dollar driven. They perceive no enhanced market value by taking a passive house approach, which is a shame because ultimately it is addressing environmental impacts and is a good thing to be doing. But they don't share that noble aspiration of trying to save the planet."

Given the many benefits of buildings that meet the standard – including higher levels of comfort, lower heating bills and good indoor air quality – there is certainly a good chance that passive houses will become more desirable.

John Dixon also feels that if more mortgage lenders followed Ecology Building Society's lead by offering preferential rates to those wishing to build to passive house standard, the market could bring about change in the private sector too.

In the meantime, Outwell is yet another successful passive house scheme that Hastoe has delivered.

SELECTED PROJECT DETAILS:

Client: Hastoe Housing Association
Architect and certified passive house designer: Ingleton Wood LLP
Main contractor: EN Suiter & Sons
Timber frame, insulation & airtightness applicators: Timber Frame Management
Cost consultants: Aecom
Structural engineer: Rossi Long Consulting
M&E consultant: Engineering Services Consultancy
MVHR: Total Home Environment
Passive house certifier: Mead Consulting
Energy consultant: Robert Flemming
Mechanical contractor: Kevin Moulton Heating, Plumbing & Bathrooms
Electrical contractor: Alpha Electrical Eastern
Airtightness testing: Anglian Insulations
Roof insulation: KJ Plastering
Floor insulation: Dow, via SIG Insulation
Airtightness products: Siga / Ecological Building Systems / Protect
Natural insulation: NBT
PIR insulation: Celotex
Mineral wool insulation: Knauf
Windows & doors: Munster Joinery
Brise soleils: WPL UK
Claddng: Rockpanel ▸

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

(top) The timber frame under construction; (left) Pavatherm Plus woodfibre insulation boards were fitted externally over the frame; (above) airtightness taping over joints, while insulated window and door reveals reduce thermal bridging

PROJECT OVERVIEW

Building type: 15 affordable new-build homes ranging from one-bedroom flats to three-bedroom houses

Location: Outwell, Norfolk, England

Completion date: May, 2015

Budget: £2.2m

Passive house certification: Certified

Space heating demand (PHPP): Average of 9 kWh/m²/yr

Heat load (PHPP): Average of 8 W/m²

Primary energy demand (PHPP): Average of 105 kWh/m²/yr

Environmental assessment method: n/a

Airtightness (at 50 Pascals): Average of 0.57ACH

Energy performance certificate (EPC): B83-B86

Measured energy consumption: n/a

Thermal bridging: Insulation installed over the timber frame to ensure thermal continuity through the intermediate floor zones. Insulated window and door reveals provided throughout (jamb, head and cills). Key details thermally modelled.

Ground floor: Powerfloated raft slab on concrete blinding over 200mm Styrofoam Floormate 300-A rigid insulation. **U-value:** 0.17W/m²K

Walls: Facing brickwork externally, on 50mm clear cavity, on 100mm NBT Pavatherm Plus insulation over 195mm deep timber frame infilled with Earthwool Flexislab RWA45 insulation (140+50mm), on Siga taped and sealed OSB3, on 50mm uninsulated timber batten zone with 12.5mm plasterboard finish and skim coat. **U-value:** 0.115W/m²K. Where brickwork is substituted for cladding, 8mm Rockpanel boards feature on 38mm battens / 38mm cross-battens over 100mm NBT Pavatherm Plus insulation (as above). **U-value:** 0.137W/m²K.

Roof: Concrete interlocking tiles externally, on 25x50mm tile battens, on breathable roofing underlay laid over trussed rafters with 300mm Knauf Earthwool Loftroll 40 laid between and over truss chord. Celotex GA4000 PIR insulation installed at the eaves pinch-point to mitigate thermal bridging. Ceiling treatment comprises taped and sealed Durelis board fixed to u/s truss chord, 25x50mm battens (uninsulated service zone) supporting 12.5mm plasterboard ceiling with skim coat. **U-value:** 0.105W/m²K

Windows: Munster Joinery PassiV Future Proof uPVC triple-glazed windows, with argon fill. Installed average **U-value:** 0.81W/m²K.

Heating system: Genvex Combi 185 EC air-to-air heat pump unit / MVHR system, with certified heat pump COP of 0.31Wh/m³.

Ventilation: As per heating system above – Passive House Institute certified 76% heat recovery efficiency.

Electricity: n/a

Green materials: NBT wood fibre insulation, Knauf Earthwool loft and wall insulation.


Photos: Image Works

North Dublin sheltered housing *provides passive care*

As people get older, their thermal energy need increases: elderly people tend to spend more time at home, and to feel the cold more. As one new sheltered housing scheme demonstrates, passive houses may be the answer.

Words: John Hearne

It might be the largest development of its kind so far in Ireland, but the 13 new units of sheltered housing on the campus of St Patrick's nursing home in Baldoyle, north county Dublin, wear their passive house credentials very lightly.

Spread across three blocks, these single-storey one and two-bed units are practically complete and awaiting their first residents, some of whom are due to move into the complex, named Alexandra Crescent, over the summer.

If the three blocks of six, five and two units look decidedly conventional, that's because they were designed back in 2009. In fact, they look exactly the same as non-passive sheltered housing units in Thurles also owned by the nursing home operator, Cowper Care and sister charity Alexandra Guild Housing Association, which were built a few years ago. The organisation has been investing in a series of new facilities over the last while in a bid to meet growing demand for nursing home places

and sheltered housing, particularly in Dublin.

Following a period when the construction of Alexandra Crescent took a back seat in favour of a refit and extension to the main St Patrick's complex that was completed three years ago, it was decided to build the units out to certified passive house standard once building work resumed in 2014.

"We have always had an interest in sustainability and technology," said Cowper Care's construction project manager, Daire Shields. "When opportunities arise to incorporate sustainable solutions, we explore them in great detail and, whenever possible, opt for them."

Cowper Care was already a firm convert to heat pump technology, having installed a large number of ground-source heat pumps, exhaust air heat pumps and air-to-water heat pumps across its sites. More recently, it incorporated heat recovery ventilation to its extension of the St Patrick's nursing home building.

As well as that, shortly before he left the organisation, Daire's predecessor had done a course on passive house as part of his professional development and had introduced the company to the idea.

So by the time the completion of Alexandra ▶

Heating and hot water are provided by an air-to-water heat pump system in each house, which consists of a NIBE F2040 outdoor unit (above) that converts heat from the air outside, and a VVM320 indoor unit (top) that distributes this heat in the most efficient way. A Brink heat recovery ventilation unit (top, attached to ceiling) will provide fresh air to the homes and should ensure high indoor air quality for the occupants

Crescent was being finalised, it had a willing cohort of people working for the organisation who were already well on the journey to becoming ready adopters of the passive house standard.

"We were immediately drawn to it as some key features included a high comfort level, health benefits and reduced running costs for the occupants," said Daire.

The recruitment of passive house trainer Darren O'Gorman of TargetZero came after Daire attended a course of his and afterwards invited him to act as a consultant for the shelter housing project. A mechanical engineer by qualification and now a chartered engineer, most of Daire's career to date has been spent working on water industry projects in Australia, but since he started working in building construction he has been impressed at the variety of high technology available to the industry. It was mainly this that prompted him to attend Darren's course so that he could "better understand the technology and the appropriate application of various products". He is now a Passive House Institute certified consultant, and also trained as a BER assessor.

On paper, deciding to build these buildings – which had not been designed as passive houses – to fully certified passive house standard seems like a bold move. After all, they are single-storey buildings with a large volume-to-surface area and few of the windows oriented to the south for optimum solar gains. Two-storey buildings tend to be much easier to work with as far as meeting the requirements go.

Getting the certification was vitally important to Daire and firm as an essential quality standard, and while he admits it was "touch and go" whether it could be achieved, O'Gorman had drawn up a very specific plan that he was confident would get it over the line – but only if it was followed to the letter.

"If you look at the [modeling] software, it was tight, I just made it," he said. Indeed, there was little flexibility for adjustments or substitute materials, and little allowance could be made for factors such as internal gains in what is closer to a retrofit than new build in terms of building form and orientation.

"In normal residential buildings there is an allowance for internal gains, but with this type of [sheltered housing] development, the internal gains are twice what it would be for residential housing."

Of course, he says that if he had been able to work from a clean sheet, the buildings would have been oriented south, they would have been two-storey, etc – basic passive house design principles that meant they wouldn't have had to insulate the roof as much as they did.

Daire says the fact that they achieved certification – just – was testament as much to a team that not only embraced the idea very quickly, they also worked together very closely and stuck to the plan.

"The main contractor, Cedar Building

Company, were heavily involved from the outset, as were the mechanical and electrical engineers, structural engineer, architect, and window supplier and installer. In a very short timeframe the team produced a practical workable solution for every detail that complied with the passive house requirements. Because the team embraced our goal and the passive house concept from the outset, the project was issue-free for the most part."

As is so often the case, the biggest challenge was achieving the required airtightness. Although the selected timber frame system includes an internal airtight layer, an additional membrane was applied to the room side of the panels in order to meet the airtightness target.

All the units have underfloor heating. Daire says if he was starting again, he would probably have chosen to provide the required heat via a district heating system, with one central heating unit per block or one for the whole development. As it stands, each unit has its own heat pump, which means quite a lot of redundancy.

"The Nibe heat pumps selected for each house are the smallest available, but would be capable of supplying heat and hot water to multiple houses if the houses were designed accordingly."

Overall, though, Daire says the project proved very interesting for all concerned. "The reaction from the design and construction teams is one of excitement, particularly having passed the final airtightness tests. There is a good buzz about it and I think everyone is delighted to have been involved in the project."

While the team are clearly happy with what they've achieved, the organisation isn't shouting about Alexandra Crescent's passive house credentials just yet. Indeed, the fact that they are certified passive houses has only been pointed out to some of the prospective residents. "They're more interested in the look of the houses and they just want to get in."

Once they are in, their short and medium-term impressions will no doubt be eagerly awaited. "We will be monitoring them very closely to determine if the living environment is noticeably more comfortable for an elderly person.

"From a temperature comfort point of view, we're really happy, but we're more interested in whether the heat recovery ventilation units actually provide the level of fresh air comfort, and whether people notice the difference."

Electricity consumption will be watched closely, too, although it's likely that the heating costs will be much lower than a conventional build, which can only be good news for its residents. "From our point of view, we aren't paying the bills, so this is giving something back to the occupants rather than saving us money."

Daire estimates that the cost of opting for the passive house standard compared with the conventional build originally tendered for was just 6pc higher, which included the heavier insulation and thermal bridge detailing, airtightness work, the MVHR system and the passive house certification.

However, Cowper Care's next construction project, a 100-bed nursing home in Kimmage, which Daire is now working on, won't be to passive house specifications, mainly due to the cost and scale, but he will be taking on board a number of the details and principles he and his team has learnt working on Alexandra Crescent.

"While a passive house takes care of the heating to a certain extent, we'd like to reduce the [environmental] impact of domestic use, so we'd look at fitting solar PVs and that kind of thing." ▶







(top row, from left) Two courses of Quinn Lite blocks to foundations to reduce thermal bridges; all units have underfloor heating installed; thermal bridging also minimised by the use of CompacFoam rigid insulation around windows and doors; (middle row, from left) Siga airtightness tapes around windows; although the selected timber frame system includes an internal airtight layer, an additional membrane was applied to the room side of the panels in order to meet the airtightness target; further airtightness detailing around service penetrations; (left) the attic features 600mm of Isover Metac insulation

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

SELECTED PROJECT DETAILS

Client: Alexandra Guild Housing Association
Main contractor: Cedar Building Company Ltd
Mechanical consultant: Codex Mechanical Ltd
Passive house certifier: Kym Mead
Airtightness consultant: Greenbuild
Passive house consultant: TargetZero
Main timber frame structure: Kingspan Century
Floor insulation: Kore
Airtight attic hatches: Ecological Buildings Systems
Airtightness & attic insulation contractor: Baker Insulation
Airtightness membranes & tapes: Siga
Heat pumps: Unipipe
Roof insulation: Isover
Thermal Breaks: Quinn / Partel
Windows: Velfac
Heat recovery ventilation: I A Kernohan

PROJECT OVERVIEW

Building type:
Building A
(comprises six two-bed houses TFA - 63m² each)
Building B
(comprises two two-bed houses TFA - 79m² each)
Building C
(comprises five two-bed houses TFA - 66m² each)
Kingspan Century Homes Timber Frame Structure on suspended precast concrete floor. Challenge - project was not initially designed to be passive house, i was hired as a consultant at foundation stage. As housing for the elderly internal gains used in PHPP is 4.2W/m² as opposed to 2.1W/m² - benefitted heat demand but not overall primary energy.

Location:
St Patricks Nursing Home, Baldoyle, Dublin

Completion date: May 2016

Passive house certification: Certified

Space heating demand (PHPP):
17 kWh/m²/yr

Heat load (PHPP): 10 W/m²

Primary energy demand (PHPP):
<120 kWh/m²/yr

Airtightness:
Ranging from 0.54 to 0.59 ACH

Thermal bridging: Two courses of Quinn Lite blocks to foundations, CompacFoam to windows jambs/head/cill & door jambs/head/thresholds.

Ground floor: 75mm screed on 300mm Kore EPS, on 75 structural screed on 200 precast hollowcore suspended floor. **U-value:** 0.10W/m²K.

Walls: Plasterboard & skim, 35mm service cavity, Siga airtightness membrane, PUR Tw55, 140mm stud with mineral wool, OSB, breather membrane, 50mm ventilated cavity, outer block rain screen. **U-value:** 0.138w/m²K

Roof: 600mm Isover Metac insulation. **U-value:** 0.076W/m²K. ***Note:*** Roof was seen as the less expensive area to compensate in a way. Buildings highly sheltered & very shaded so not much benefit from solar gains in heating period.

Windows: Velfac 200 aluclad windows. **Uw:** 0.85W/m²K, **g-value:** 0.5 and **Ug-value:** 0.53

Heating system: NIBE F2040 outdoor air to water, NIBE VVM320 indoor unit. 6kw to cover heating & hot water (higher hot water demand as housing for the elderly).

Ventilation: Passive House Institute certified Brink Renovent Sky 150 in each. 84% eff, 0.44W/m³h elec. eff.

Electricity: Whole House BMS system to include data for heating / electric / ventilation.

Passive 'barn' house

makes an elegant addition to the

Connemara Coast

This new home in Galway is inspired by local buildings but doesn't look like anything else in the area, and delivers passive performance along with panoramic sea views.

Words: Lenny Antonelli

Photos: Gerard Conneely

Driving west from Galway City along the north shore of Galway Bay — through an area known locally as Cois Fharraige (meaning 'beside the sea') — one village blurs into the next in a blitz of bungalows that continues for more than 30km. This coastline contains some unfortunate examples of one-off rural architecture, dating from the 1960s right up until the boom.

Which is what makes this new barn-inspired passive house in Indreabhán by New Zealand-born, Galway-based architect Lester Naughton all the more special — it manages to be heavily inspired by the local vernacular yet unlike anything else in south Connemara. Put simply: there are plenty of barns out here, but this is the only one that's a house.

I met Naughton, builder Niall Dolan of GreenTec Eco Homes and homeowner Máire Aoibhinn Ní Ógáin at the house on a grey April day, as showers swept the west coast. For Naughton, the form of the house simply followed function — he wanted to raise the living spaces to make the most of its vista over Galway Bay, so a barrel-roof, inspired by the surrounding agricultural buildings, was an obvious design choice.

"Here in Connemara it's quite a sensitive area, and you want to get up to get a view," he says from the kitchen, as we look out over the patchwork of small fields to Galway Bay. "But If we made the same thing and put a pitched roof on it, it'd be a metre and a half or two metres higher."

This would have made it difficult to get planning, and what's more, Máire Aoibhinn wasn't keen on a dormer with a pitched roof anyway. She had met Naughton at the Simon Open Door, an annual event at which architects give consultations to members of the public and then donate their fees to the Simon Community. Luckily for Naughton, she gave him the freedom to pursue his own vision for the house — and to build it to the passive house standard (while she was keen on a warm and energy efficient home, she didn't insist on passive).

The project flew through planning. And in this sensitive landscape, it stands out for all the right reasons. It's also deceptively small, with just 113 square metres of floor space. Downstairs, there are two bedrooms, a bathroom and a utility room. Upstairs, there's the master bedroom, a bathroom and a small sitting room. And on a mid-level in between on the east side of the house, there's a large height-and-a-half kitchen, overlooked by the first floor living area.

The kitchen extends right up to the roof, where a row of feature lighting sits in the gap between the white-painted walls and the vaulted OSB ceiling. "Passive wise that's a compromise," Lester says about the strip lights, laughing. "That gap could have been filled with insulation."

Walking around the house, what's immediately apparent is the intelligent floor plan — how cleverly the rooms fit together to maximise the efficiency of the internal space, which again sets it apart from your average sprawling boom-era bungalow. "It's very easy to make it too big, or big and not efficient," Lester says. "Every metre costs you the same, roughly. Why build a square metre you don't need? That's my take." Máire Aoibhinn shared this belief too, and even sacrificed an en suite in the master bedroom to have more space.

From the kitchen, the large Nordan triple-glazed timber-aluminium doors face south across Galway Bay to the Burren. The doors open out onto a timber deck, with a ramp from this leading down into the back garden. This satisfied Naughton's desire to raise the living spaces while keeping them connected to the garden. "There's probably a bit too much window in terms of purely thermal [considerations]," he says, "but you're not going to cut out the view."

All that glazing poses a thermal challenge in two ways: it can let too much heat escape from the house in the winter, and let too much heat in during the summer, creating a risk of overheating. Naughton dealt with the first challenge by beefing up the insulation spec in the walls, adding rigid insulation boards to both the outside and inside of the timber frame.

The threat of overheating posed a more complex challenge. "I'm more worried about new houses being too hot than too cold," he says. According to PHPP, the passive house design software, the house is likely to overheat (ie, rise above an internal temperature of 25C) up to 20% of the time until some curtains are installed on the south façade, which will drop the figure down to 8%.

But Naughton would rather allow this overheating in the design calculations and give his client the ability to mitigate it with large openable windows and good ventilation than design it out with solar shadings, which might block the sweeping sea views (though there are 12 square metres of solar PV panels which provides some shading to the south-facing glass). "When you're in the Irish countryside, and

you're not in an urban situation, and there aren't security or noise issues, as long as you can open the windows and get the air through, you're going to get to outside temperature, and in Ireland that's rarely over 25C," he says. Máire Aoibhinn also says that because she lives alone and is at work during the day, she's usually not home to experience any overheating that does occur.

Máire Aoibhinn says the house can get quite warm inside if she's cooking, or if she has lots of guests. But opening the right windows on either side of the house creates an effective cross-breeze. "It'll cool down reasonable quickly," she says. As a timber-frame building it'll cool down quicker than a masonry one, too.

The thermal mass of the exposed concrete floors downstairs also helps to soak up excess heat. The concrete warms up so much that guests ask if she has underfloor heating (she doesn't).

Besides the polished concrete, one of the principal materials you notice inside is the exposed OSB, used for both the ceiling and staircases. It's a clever alternative to expensive timber cladding and a nice way to show off the house's timber structure.

For Naughton, building the house with timber was the obvious choice — given the height of the walls, building with blockwork would have required a lot more structural steel. The timber frame supports the load of the steel that's needed to form the curve of the roof, so there's no need to rest this steelwork on the foundations.

Meanwhile, the steel that frames the large sliding doors does sit on the foundation, but is isolated with a thermally broken plate, and well insulated on its external and internal surfaces.

The timber frame was built by local manufacturer Irish Eco Homes and features 220mm of mineral wool between the studs, plus rigid insulation boards outside and inside, while the roof contains 400mm of pumped cellulose. "We saw it as an interesting and challenging project for timber frame with its vaulted barrel ceilings and double height spaces," says Adrian Gallagher of Irish Eco Homes. "It required experience and ingenuity, culminating in the frame erection taking just five days."

I ask Naughton if hitting the passive house airtightness target of 0.6 air changes per hour was straightforward. "With this guy," he says, pointing to builder Niall Dolan, "yeah, it was." Dolan in turn praises the quality and detail of Naughton's design drawings.

The house is principally heated by a Nilan Compact P unit, which combines heat recovery ventilation with a small air-source heat pump. The heat pump provides both hot water and space heating — priority space heating is via a 1.5kW post heater in the supply air of the ventilation system, then to towel radiators in the bathroom, all of which are thermostat and timer controlled.

"It wasn't even quite finished in February 2015, and I don't know how many days I went out of the house in a t-shirt, and the car was frosted. It's bizarre, it's like a completely different climate"

There's also a small, standalone solid fuel burning stove in the kitchen – a room sealed unit with external air supply. Passive house occupants often report that their stoves are redundant, but not this one. "You'll notice the darker days, it'll be cooler when you come home in the evening, and you'll put on two briquettes. It heats up really quickly, the whole place gets warm really quick. It's nice to look at as well, as part of the aesthetic," Máire Aoibhinn says of the stove.

Lester Naughton says that, even when he designs a house close to passive standard, clients often want a full central heating system. But he says that for the same price as a boiler and full set of radiators, he could spec the Nilan Compact P, which can deliver space heating, cooling, hot water and ventilation.

While the house was submitted for passive house certification, it's unlikely to achieve it now because the windows fall just short of the required thermal performance. But according to Lester's calculations the overall space heating demand is inside the passive house target of 15kWh/m^2/yr.

Máire Aoibhinn says the house is a remarkable contrast to one that was on this site before, and which was knocked to make way for this one. Her old home had no attic insulation, no central heating, and the kitchen was even prone to frosting inside.

But she was amazed by the warmth of her new house almost as soon as she moved in. "It wasn't even quite finished in February [2015], and I don't know how many days I went out of the house in a t-shirt, and the car was frosted," she says. "It's bizarre, it's kind of like a completely different climate…the biggest complaint people have is that they're too warm."

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

SELECTED PROJECT DETAILS
Client: Máire Aoibhinn Ní Ógáin
Architect: Lester Naughton Architect
Main contractor: GreenTec Eco Homes
Timer frame: Irish Eco Homes
Structural engineer: Seamus Glacken Consulting Engineers
BER: Architecture Energy
Mechanical contractor: Western Energy Systems
Electrical contractor: F&H Electrical
Airtightness testing: 2eva.ie
Airtightness products: Partel Passive Building Supplies
Mineral wool insulation: Isover / Knauf
Phenolic insulation: Kingspan
Thermal breaks & PIR insulation: Quinn Building Products
Windows & doors: Nordan Ireland
Heat pump & ventilation: Nilan Ireland
Stove: Murphy Heating

(Clockwise, from right) The barrel-roof was inspired by the surrounding agricultural buildings and helps to minimise the height of the house without sacrificing the views over Galway Bay; Ampatex airtightness membranes were installed in the walls and roof; airtightness taping around windows and over edges of PIR insulation; the timber frame was built by local manufacturer Irish Eco Homes and was erected in just five days; the lower ground floor features 200mm Kingspan K3 insulation – including channels cut into the top of the insulation layer to house the MVHR ductwork – with 70mm K3 insulation upstand to edges

PROJECT OVERVIEW

Building type: 113 square metre detached two-storey split level timber frame house.

Location: Indreabhán, County Galway

Completion date: January 2015

Budget: €250,000

Passive house certification: Not certified

Space heating demand (PHPP): 15 kWh/m²/yr

Heat load (PHPP): 14 W/m²

Primary energy demand (PHPP): Not calculated

Airtightness: 0.50 ACH at 50 Pa and 0.50m³/m²/hr at 50 Pa

Provisional BER: A2 (awaiting final figures)

Thermal bridging: Rising foundation walls in Quinn Lite block at insulation line. Timber frame wall internal insulation overhanging slab with edge insulation 70mm thick. Internal load bearing walls bearing on concrete slab on insulation without rising wall. Steel in timber frame minimised with limited steel bearing to foundation and then cold bridging minimised with steel lined with 130mm insulation internally in combination with thermal isolation plates at floor level. 0.08 Y-value utilised default Irish ACDs with no secondary calculations.

Lower ground floor: Rising walls with 150mm wide 430mm deep Quinnlite B3 block to floor level. 100mm concrete slab on separation layer, on 200mm Kingspan K3 insulation, with 70mm K3 insulation upstand to edges. **U-value:** 0.10 W/m²K

Upper ground floor: Suspended timber floor. 18mm OSB flooring on 50mmx50mm battens at 400 crs, on airtightness membrane, on 225x44 Joists at 400 crs with 220mm Knauf wool batt insulation between and 80mm PIR insulation to underside. **U-value:** 0.12 W/m²K

Walls: Corrugated metal cladding on 35x50 battens, on Ampatop F2 building wrap, on 60mm Quinn Therm PIR insulation, on 225x44 timber frame with 220mm Knauf Wool insulation infill. Ampatex DB2 airtightness membrane and 50x50 battens at 600crs forming services zone filled with Isover Metac batt insulation and 82.5mm PIR insulation backed plasterboard. **U-value:** 0.12 W/m²K

Roof: corrugated metal roofing on 35x50 battens at 440 crs, on 18mm wpb ply counter battens at 600 crs (bent to curve), on Ampatop breather membrane, on 2 layers 9mm OSB board, on 225x44 rafters at 400 mm crs (approx) with Ampatex DB2 airtightness membrane to underside and voids filled with pumped cellulose insulation. 50mm battens to underside of rafters forming services zone filled with 50mm Isover Metac batt Insulation with 18mm ply counter battens forming curve and 9mm OSB ceiling lining (with flame retardant treatment). **U-value:** 0.13 W/m²K

Windows: Nordan N tech Aluclad thermally broken timber windows. Triple-glazed with low e argon-filled triple-glazing, 0.51 g factor generally, with an averaged overall **U-value** of 0.83 W/m²K

Heating system and ventilation: Nilan Compact P combined heat pump, hot water storage and mechanical heat recovery ventilation. Passive House Institute certified to have ventilation heat recovery rate of 77%. Boost space heating with 1.5KW in-line electric fan heater on living room air supply ducting. 180 litre integrated hot water storage tank.

Stove: Termatech TT20 wood burning stove with ducted in air supply in living area certified 83.4% efficient to EN13240.

Electricity: 5 Gintech solar PV panels, each with max output of 250 Watts each.

Green materials: Timber framed construction, cellulose insulation to roof, GGBS in foundations.

Photos:Max McClure

"Although retrofitting to the Enerphit standard added to the capital outlay, grant funders were willing to advance more because of it."

Victorian stone building

becomes Enerphit youth hostel

Old buildings are tricky to upgrade – especially if external insulation's not allowed. Utilising a combination of cutting edge building physics and a carefully selected palette of insulation materials, one Victorian stone building has been upgraded to the Passive House Institute's Enerphit standard, slashing heating demand by 90%.

Words: Kate de Selincourt

The old Barrel Store in the centre of Cirencester in the English Cotswolds has had a few incarnations in its 140-odd year life. Solidly built in the local Cotswold limestone, it started life as a warehouse for the adjacent brewery, which closed sometime in the first half of the 20th century. The building was later scheduled for demolition, but was instead rescued and lived again as a theatre. However a couple of years ago, it was accepted that the building really was no longer fit for this purpose, and the theatre was closed.

The theatre had been managed by the New Brewery Arts charity, which occupies two other former brewery buildings next door. The charity had an option to retain the building, and decided that offering hostel accommodation would widen access to the many craft courses they run to visitors from further afield. It would also offer budget accommodation in what is otherwise an expensive town.

New Brewery Arts began to look for a design team, and Peter Holmes of Potter and Holmes architects teamed up with Toby Cambray of Greengauge energy and proposed an Enerphit retrofit for the building.

As chief executive Beth Alden explains, this made immediate sense to the charity. Their main premises were converted in 2008, but the conversions did not pay much attention to energy use, meaning bills are very high.

"Low running costs were identified as a big priority for us. We have learned from these previous builds that it is really important to pay attention to energy, and to exactly how the building is going to be used."

Beth Alden adds: "The fact that the building would be cheap for us to run was important to our funders, as they could see how it impacted on the financial sustainabity for the organisation. And they were also very interested in the environmental credentials – they felt they could support that aspect in particular."

Insulation strategy

While the Barrel Store was luckily not a listed building, it lies within a conservation area so unsurprisingly the planners had "very clear requirements about the alterations to the elevations," Peter Holmes explains – so internal insulation was a given. This set up an immediate tension – a higher insulation value means thicker insulation – which meant less space inside for bedrooms: but with too few bed spaces, the hostel might not have been financially viable. The hostel is part of the YHA [Youth Hostel Association] chain. The association suggests around 40 beds is the minimum size of hostel likely to make sense.

Internal space was therefore critical. Quite a bit of juggling of layouts was required – at one point, there was even a proposal to install slightly-shorter-than-standard beds – but the team managed to deliver a layout that accommodates 43 (standard sized) beds in a mixture of room configurations, while still insulating to the levels required for Enerphit.

Converting from a theatre to a hostel required not only new internal partitions but two new internal floor levels, so new load-bearing internal structures were going to be needed.

The team opted for a 'building in a building' – a new three-storey loadbearing timber structure would be built up off a new insulated slab, and thermally isolated from the ground and walls.

Changing the floor level made it possible to accommodate an exceptionally thick depth of EPS insulation beneath, making it easier to achieve Enerphit levels of insulation overall.

Moisture

Internal insulation always has to be managed carefully, because the masonry behind the insulation in a heated building will become colder than before, increasing the risk of condensation, and slowing down the rate at which the masonry can dry out. This increases the risk of damage to the existing stone, new timber structure, and the insulation itself.

The most risky area is generally the interface between the masonry and insulation. The initial strategy proposed at the Barrel Store was to create a ventilated cavity at this point, so any moisture could be directly vented to outside, with a PIR-insulated internal structure physically separated from the masonry. This is the same approach as used by the Green Building Company for their retrofit of the Cre8 Barn at Stirley Farm in Yorkshire.

Despite the break between masonry and ▶

interior, this approach still needed careful thought, however, as Toby Cambray explains: "Even though the cavity would form a capillary break, there is a risk that moisture could accumulate in the cavity if ventilation was insufficient. There is a lack of research or guidance in this area so it's quite uncertain and therefore a risk with potentially severe consequences."

"We therefore modelled the proposed structure in Wufi to check how it was likely to perform."

Dynamic modelling such as Wufi is more sophisticated than the Glaser calculation that is sometimes used to check for interstitial condensation. Glaser assesses vapour diffusion through structures (from inside to outside, during the heating season in the UK) by calculating vapour pressure at interfaces of different materials on an averaged monthly basis; Wufi models vapour diffusion on an hourly basis throughout the fabric, so can account for dynamic processes, such as sun on the external surface, that drive vapour diffusion the other way. Crucially, Wufi also models the movement of liquid moisture – usually from outside to inside, as rain wets the outside of the building and soaks into the masonry.

"Wufi modelling of this proposed approach showed that a sufficient ventilation rate was critical to averting the risk of condensation on the cold surfaces in the cavity," Toby Cambray explains. At Stirley Farm there was room to leave a 100mm cavity; but at the Barrel Store, there was space only for a 25-50 mm cavity, which was potentially more vulnerable.

In the end a different approach was adopted, with a wood fibre internal insulation system applied directly to an internal lime plaster parge layer. This is a similar approach thermally to the previous proposal, with a new timber interior structure thermally separated from the walls and floor. However as Toby Cambray explains: "There is now direct contact between inside and outside, so as well as vapour to think about, there is also the potential for capillary transport of moisture between the masonry and insulation material."

Detailed moisture modelling for the wood fibre system was carried out by supplier Natural Building Technologies, to predict how moisture in the wall was likely to behave, particularly in the critical risk area where insulation meets the relatively more vapour resistant masonry. NBT's Matthew Smith explains that this analysis is especially important with porous masonry such as limestone or brick, where the inwards movement of liquid moisture from rain-wetted masonry is as important as the outwards movement of water vapour.

If the moisture level at the interface remains above 20% for prolonged periods of time, there is considered to be a risk of mould and rot damage. As Matthew Smith reports, their modelling suggested that although the moisture levels at the interface may peak briefly near 20% once a year during the winter, the wall will dry out relatively rapidly as the weather warms up. The physical properties of wood fibre are helpful here in keeping the risk low:

"Wood fibre is vapour permeable, so as well as drying direct to the outside air, moisture in the masonry can dry towards the inside of the building (to be removed by the ventilation) – this is critical in keeping the moisture below risk levels. This process is assisted by the insulation being dense enough to absorb vapour as it passes outwards from the warm interior, and it also allows capillary movement of moisture from areas of higher to lower concentration, from which it can evaporate."

Matthew Smith adds that the assumptions in their Wufi model are pessimistic, for example assuming lower airtightness, and treating the masonry as a homogenous layer when in fact the walls are likely to have a loose rubble core with numerous air gaps, meaning that the capillary tracking of rain across the thickness of the masonry is likely to be less than the assumptions in the model.

See graph of moisture content of the insulation layer immediately adjacent to the critical interface of insulation and masonry substrate on the opposite page. The peak moisture content of the wood fibre insulation settles around 20%. Once settled there is no net increase year on year, which is important to confirm that there'll be no moisture accumulation on a long-term basis. Pronounced fluctuations show significant drying out in the summer.

Despite the fact that the Barrel Store is not a completely detached building, with the ventilated cavity the whole of the outside of the insulated structure would have been in contact with air at outside temperatures, so had to be modelled as though it were detached.

But with a continuous insulation buildup, these wall areas would instead be up against a heated building the other side, so would no longer contribute to heat loss. This reduced the need to push the U-values quite so hard, while still achieving the 25 kWh/m^2 annual heating demand required in Enerphit – with a similar thickness of build-up inside (around 25cm), despite the lower insulating properties of wood fibre per mm, compared to PIR.

Airtightness

With any passive house project, the contractor can make or break the success of the build, and it was clear from the start that DJP had the right approach. "We have worked with them before," says Toby Cambray, "they are very good at finishing on a building, and this translates well into the care needed for airtightness."

"Their sites are always immaculate, very clean and carefully swept. The foreman is pretty obsessive about neatness – which is ideal!"

Airtightness in the floor and walls was relatively straightforward to achieve, thanks to the use of a poured slab, and the careful taping of membrane on the inside of the timber frame by the site team. Where joists had to be set into the structure, collaboration between contractor and Greengauge got round any difficulties, as they worked together to devise a good way to pre-fold the membrane around the joist ends.

Airtightness in the roof was a bit trickier, as the

(above) The decision was taken to change the floor levels and install an insulated slab, which would also help to thermally isolate the new three storey load bearing structure from the ground and walls. 230mm of Hexatherm XPS insulation was installed to deliver a U-value of 0.094

(above, from top) Wood fibre insulation board, fixed directly to the existing wall, was selected primarily for moisture management properties; followed internally by the timber frame with more wood fibre insulation; and then by an airtight vapour barrier; condensation risk was assessed with Wufi, including this simulation of moisture content in the insulation layer with 100mm Pavadentro + Pavatex DB 3.5 + 80mm Pavaflex between studs on the south west elevation

structure was not being replaced, meaning the trusses penetrate through the airtight layer to outside. Membrane was taped around the trusses at each penetration to ensure airtightness and protect the cold trusses from warm indoor air.

However, some of the bottom chords had deep splits along their length as they passed though the air barrier, bypassing it. The structure had been repaired, but the splits remained. Simply taping membrane around these chords where they left the roof void would not stop potential air leakage, so the affected sections were completely wrapped in membrane to isolate them fully.

Sections of three trusses that had longitudinal splits were wrapped in airtight membrane, then additionally protected with OSB boxes.

Services

In passive house and Enerphit homes, the energy needed to meet hot water demand tends to be similar, or a bit greater than, space heating energy. In the Barrel Store there is a much higher density of occupants (up to 43 people in under 300m^3, ie roughly equivalent to just three family homes). And a modern hostel includes a lot of ensuite facilities – they are more luxurious than veteran hostellers might imagine! This means water use dominates the heat demand, so the heat strategy is very much geared around hot water.

Greengauge therefore specified a big gas-fired water heater which heats a 370 litre cylinder. The showers are the YHA standard, with a reasonably modest flow rate (8l/m), and the hot water unit can supply roughly 40 showers in two hours.

A little of this heat is diverted into space heating when needed: a small 10kw plate heat exchanger 'robs' heat from the cylinder and sends it around the hostel's small radiator circuit.

The radiators are not the only source of space heating: 40 sleeping bodies each producing around 100W adds up to around 4kW (around 15 W/m^2!) when the hostel is full – and then of course there are the internal gains from hot water use.

Averaged out over the likely variation in occupancy across the day and across the heating season, the PHPP estimate for internal gains from (mainly) the hot water and occupants comes to 4.1W/m^2. During the heating season this makes a significant contribution to the overall heating needs of the space: very nearly half of the space heating demand of the building is met via internal gains (solar gain in this building is minimal because the constraints of the historic fabric mean the windows are small, and very deeply recessed).

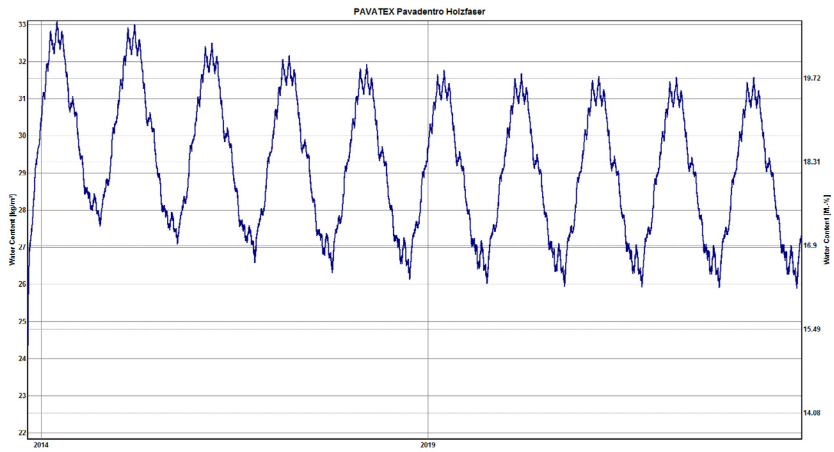
Dynamic modelling of the impact of internal gains in warm weather however shows no significant risk of overheating in PHPP, says Toby Cambray. "All rooms have an openable window, but even with the air change rate set very low (ie a "stress test" of the design) PHPP showed 0% overheating. The design appears robust."

Just as this densely occupied building requires a lot of hot water, it also needs a lot of ventilation, relative to the floor area. This is provided by two separate heat recovery ventilation units, allowing differential control of ventilation rates when, for example, the communal areas of the building are in use but the bedrooms unoccupied.

Small bedrooms may contain three or four people in bunk beds, so providing a sufficient fresh air supply/moist air extract rate requires quite a high ventilation rate for the room size – translating to as much as one air change per hour. Ventilation to the ensuite bedrooms is in a 'closed cell' pattern, with air supplied to the bedroom and extracted from the bathroom. This means that there is no need for air to pass in from the corridor – meaning, no need for undercuts or door vents, which is very helpful for privacy and quiet.

Particular care had to be taken over noise, as the plan of the building is too narrow to allow for the typical hotel approach of placing the bathrooms between the sleeping area and corridor. Valuable advice was given by acoustic consultancy Ion, to ensure that bedrooms were quiet nevertheless; for example, plasterboard in the bedrooms was fixed with acoustic isolation mountings, and the corridor ceilings are finished with anti-reverberation boards.

To minimise noise from the ventilation, as well as in-line acoustic attenuators, where the ducts pass though the ceilings a short section of soft, padded duct replaces rigid steel, cutting possible noise transmission into the timber structure. ▶



AECB building knowledge

2016 Annual Conference

15-16 July 2016

The Enterprise Centre
University of East Anglia, Norwich NR4 7TJ

THE AECB ADAPT CONFERENCE

Register now for the 2016 AECB Conference

Venue: The Enterprise Centre - shortlisted for Architects Journal Building of the Year

Technical workshops | Pow Wow interactive sessions | Debate
Practicals | Tech talks | Discussion | Site visits and building tours

More than 25 fascinating speakers and industry experts lead a packed programme exploring the following key themes

Designing and building The Enterprise Centre
Airtightness and Ventilation
CarbonLite Retrofit
Case studies and self builds
The latest on skills and materials

Plus: exhibitors, onsite accommodation, conference dinner

DOWNLOAD THE FULL PROGRAMME NOW AT WWW.AECB.NET

OPEN TO NON-MEMBERS

Organised by:

AECB building knowledge

REGISTER AND BOOK ACCOMMODATION ONLINE AT WWW.AECB.NET

New Brewery Arts have used the furnishing of the building to showcase local crafts – blankets from a local woollen mill are on the beds, for example, and the glass lampshades were made in the studio next door. The Barrel Store is expected to receive its Enerphit certificate soon, but the first guests have stayed and are already giving it the thumbs up – as one New Brewery Arts employee reports: "I popped round to collect something, and one of our guests, who didn't realise I was a member of staff, insisted I came in so she could show me how lovely it was – which is a pretty good endorsement I think!".

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

SELECTED PROJECT DETAILS
Client: New Brewery Arts
Architect: Potter and Holmes
M & E engineer / energy & airtightness consultant: Greengauge
Civil / structural engineer: E&M West
Project management: Magna
Main contractor: DJP Construction
Mechanical contractor: Pure Plumbing & Heating
Electrical contractor: Phillex
Wall insulation: Natural Building Technologies
Roof insulation: Quinntherm / Celotex
Floor insulation: Cellecta
Airtightness products: Natural Building Technologies / Icopal
Thermal breaks: Schoeck
Entrance doors: Zyle Fenster UAB
Windows: Rationel
Roof windows: Fakro
Heat recovery ventilation: Helios
Gas boiler: A.O. Smith
Radiators: Stelrad
Lighting: Aurora

(top right) Sections of three trusses that had longitudinal splits were wrapped in airtight membrane, then additionally protected with OSB boxes; ductwork for the MVHR system

PROJECT OVERVIEW

Building type: A stone warehouse in an urban conservation area, refurbished and converted into an Enerphit youth hostel. 265 sqm TFA

Location: Cirencester, Gloucestershire, England

Example Budget: £1.18m

SPACE HEATING DEMAND
Before: 228 kWh/m²/yr
After: 23kWh/m²/yr

HEAT LOAD
Before: 92 W/m²
After: 13 W/m² (3.5 kW)

PRIMARY ENERGY DEMAND (PHPP)
Before: unknown
After: 122 kWh/m²/yr

AIRTIGHTNESS (AT 50 PASCALS)
After: 0.58 air changes per hour

WALLS
Before: ~500mm solid Cotswold stone. U-value: 1.6 W/m²K (estimate)
After: 80mm Pavadentro direct fixed to existing walls, 90mm Pavaflex between timber frame, Pavatex DB 3.5 airtight vapour barrier, service void. **U-value:** ~0.19 W/m²K (slight uncertainty over stone conductivity).

ROOF
Before: Pitched roof with 50mm Styrofoam or similar. ~0.7U
After: PIR insulation added internally. Original plasterboard and insulation left in situ, ventilated void created between old and new insulation layers. 0.104 W/m²K excluding thermal bridging, which was accounted for separately.

FLOOR
Ground floor: 175m Reinforced concrete slab with 350mm Hexatherm XPS insulation above. **U-value:** 0.094 W/m²K

Thermal bridging detail: Novel use of Isokorb load-bearing thermal insulation elements, used to connect up two new steel tie straps to stop the walls 'bellying out' any more than they already are. Isokorbs run through at first floor level within the floor zone.

WINDOWS & DOORS

Before: Single-glazed, timber windows and doors. **Overall approximate U-value**: 3.50 W/m²K

New triple-glazed windows: Rationel Aura triple-glazed. **Overall U-value:** ~1.1 W/m²K

ROOF WINDOWS
Fakro FTT U8 thermally broken triple-glazed roof windows with thermally broken timber frames. **Overall U-value:** 0.99 W/m²K

HEATING SYSTEM
Before: ~5 year old gas boiler & radiators
After: A.O. Smith direct gas-fired water heater supplies the hot water; 368L, 58kW. A small plate heat exchanger 'robs' heat from the cylinder.

VENTILATION
Before: Dysfunctional displacement vent systems serving theatre. Windows only in ancillary spaces.
After: Two No Helios W: 700 D heat recovery ventilation units, Passive House Institute certified efficiency of 82%

GREEN MATERIALS
Wood fibre insulation to wall – selected primarily for moisture management properties: There was not a strong emphasis on green materials. Floor packed up with reclaimed concrete planks. Solid oak staircase.

Photos: Image Works

Wicklow step-by-step retrofit reveals

new way to go passive

This pioneering deep energy upgrade of a 1960s home in Wicklow will take place in phases over at least five years, with the aim of making it more affordable to go passive by renovating on a step-by-step basis.

Words: John Hearne

The most daunting aspect of any building project is always going to be the cost. Deep retrofits, designed to transform the comfort and thermal profile of a building, don't come cheap. One solution is to stagger the work, to create a long-term plan in which that transformation is phased over ten, fifteen, even twenty years.

That's exactly what Mariana Moreira and Art McCormack did when they set out to retrofit their 1960s built/1990s refurbished family home — dubbed Stella Maris — on an exposed hillside in Co. Wicklow.

It's fair to say the couple have passive house running through their veins. McCormack is a co-founder of passive house architects and consultants MosArt and the Passive House Academy. Moreira and McCormack – both of whom are architects and certified passive house designers – both work for the two organisations, and therefore knew that an exposed location doesn't have to mean a cold house.

"I can see the north pole from here," says McCormack, "or at least that's what it feels like when the wind blows from the north and from the east off the sea." The wind whistling through the house – carrying all the heat away with it – was what prompted the need for the retrofit in the first place.

Adopting a phased approach was all about making the works affordable. And, as Moreira points out, by front-loading the work that will deliver the highest energy savings, those reduced running costs free up resources that can go towards future works. ▶

As part of the first phase of refurbishment, the front of the house was insulated externally with 250mm platinum EPS insulation with a Parex Lanko silica render finish (top); Compacfoam was installed (bottom) at door threshold to combine insulation and structural needs; (above) an improvised starter rail of flexible DPC fixed to the wall and metal rail pushed further out was deployed to reduce thermal bridging;

The project – which will aim for the passive house retrofit standard, Enerphit – is a participating project in the Passive House Institute's (PHI) Europhit programme, which supports step-by-step Enerphit projects. Europhit has also produced a brochure that highlights its successes and showcases a series of demonstration projects (including Stella Maris) underway in 11 EU member states.

"It's estimated that 80% of retrofits in Germany are completed on a phased basis," says Moreira, "so there is a need to develop a good strategy showing how to do this in a proper way and in a cost-effective, energy efficient and technically feasible manner."

To that end, developing — at the outset — a thoroughly detailed plan which specifies the full scope of the works across all phases is vital.

At Stella Maris, McCormack and Moreira have planned three phases. The first, completed last November, centred on retrofitting the roof and northern elevation. The second phase, due this summer, comprises mainly internal works, and includes the replacement of the original open fire with a wood burning stove. The final phase — planned but not yet scheduled — will see the completion of the remaining elevations together with a 'modest' extension facing south in the central portion of both floors.

Phasing works throws up a variety of issues that don't arise in one-fell-swoop retrofits. At what point do you think about ventilation for example? If airtightness is to be improved, a ventilation strategy needs to be put in place, but does it need to be implemented in the first phase, second or the third phase?

"The owner must have consultant expertise behind him to guide him through the process," says Moreira, who adds that the Europhit project also provides the much-needed guidance and theoretical rigour to support step-by-step plans.

"If you're going to retrofit your house starting today and you gave yourself four months to do so," says McCormack, "it doesn't matter if there are bits and pieces sticking out here and there. At the end of the project, everything is tidied up and you get the continuity, but when you have to pause for five, ten or fifteen years between steps, then you have to anticipate unbroken continuity in insulation and airtightness, and consider how that will be achieved."

A close look at Stella Maris reveals how the completed first phase anticipates the work to come. The orientation of the house presented something of a challenge. Views of the sea and mountains lie to the north, while the southern aspect looks immediately to the upward slope of a planted hill. Moreover, the house itself stands at quite a high altitude, putting it, as McCormack points out, in the direct line of fire of the north wind.

This is why the first phase centred on the roof and the front elevation. "A key catalyst for this project", says McCormack, "was the infiltration by wind, penetrating under roof tiles and bitumen-based roof felt and through fibreglass, frequently negating its insulation value. It also cut between the joists of the suspended floor and up between floor boards to further rob the house of its space heating."

The roof was stripped back and an airtight layer installed above the rafters, surmounted by two separate layers of Rockwool insulation. In addition, 100mm of mineral wool was installed between the rafters. The insulation, wind-tight and airtight layers were continued down to the verge overhang, where they now sit, awaiting the completion of external insulation on the gable walls at a later phase.

Hitting the pause button on a retrofit project throws up aesthetic issues too. If some elevations are left untouched, does this mean you get ugly overhangs that just can't look good until the project is completed? What about windows? If you're replacing windows now but not externally insulating until five years' time, how do you position them so that you get optimal performance and a reasonable aesthetic between phases?

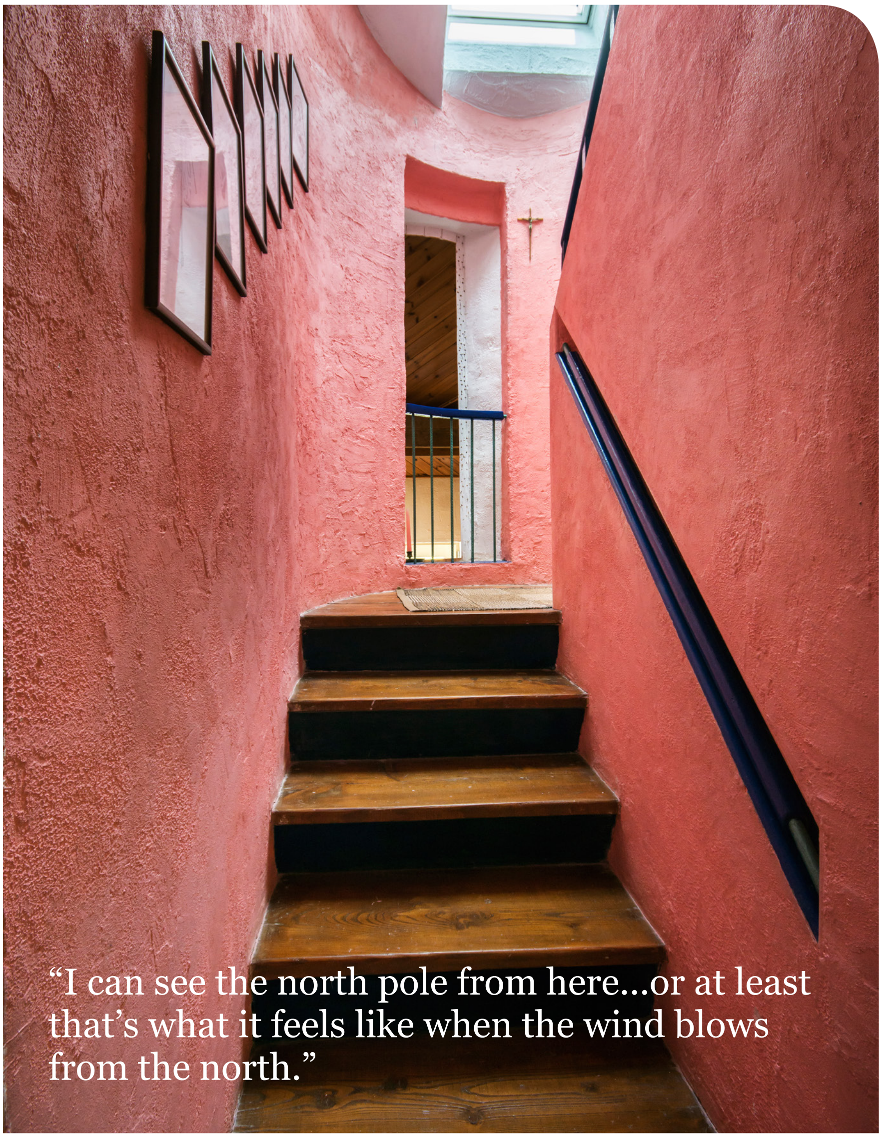
Moreira says that these are certainly challenges, but suggests that they're really no different to the architectural challenges presented by any retrofit project. She points to a number of projects where these issues were handled in creative ways.

"There is a potential to look odd; one façade looks new but this other façade looks dull... our front façade has new windows and door and it looks very nice and sharp, then you look around and see the other façade unchanged...but you can work around this. It's down to the architect to be clever and mitigate these issues," she says.

There's always a risk too that by the time you hit phase two, all of the great things you did in phase one will seem outdated and you will be niggled into revisiting work.

Beware, says Mariana Moreira, of the

(right, from top) The external grilles for supply and extract vents for the heat recovery ventilation system; Ollie McPhillips commissioning the ventilation system; a section of the stainless steel spiral ductwork; (below) photos showing how the original cottage was renovated and extended during the 1990s



> "I can see the north pole from here...or at least that's what it feels like when the wind blows from the north."

(above) Insulation and airtightness details of the new roof build-up, including (bottom left) 100mm mineral wool installed between rafters; (middle left) two separate layers of Rockwool insulation outside existing rafters; (middle right) externally insulated chimney stack and Pro Clima Solitex Plus membrane over Rockwool insulation; (bottom right) airtight layers were continued down to the verge overhang, awaiting the completion of external insulation on the gable walls at a later phase

'lock-in' effect. "That's when you do the bare minimum, when you get non passive house certified windows or rooflights for example. To avoid that risk, you should really go for the best on the market at that moment."

She points out too that this year's passive house conference in Darmstadt saw a review of the performance of the first ever passive house built by PHI co-founder Dr. Wolfgang Feist 25 years ago. Despite the fact that all of the components used in that house are now well out of date, they continue to deliver excellent results and do not need replacing.

The house's west façade — a remnant of the original cottage — includes an architectural feature that's about as far away from passive house convention as possible: a scattering of glass blocks cut into the 215mm block construction when McCormack renovated and extended the house in the 1990s.

Inspired by Le Corbusier's chapel of Notre Dame du Haut, the blocks add an architectural flourish. "It's as is if it's water reflecting from the walls," says Moreira. This wall wasn't touched during the first phase of the Enerphit project, but as Moreira explains, it will be tackled when the remaining walls are externally insulated in the next phase.

"We will keep those glass blocks visible, so we'll have to cut holes in the external insulation. We know it's a weak point in the thermal envelope, and we have accounted for those heat losses in PHPP [the passive house design software], and it's not affecting the result as it's such a small area.," she says.

"In Enerphit projects we have to be aware of these weak points and mitigate against them in terms of thermal bridging and condensation risk as much as possible, but existing building fabric has its own value and history. It would be a pity to be narrow-minded, and to lose architectural features. The architectural integrity shouldn't be compromised for the sake of thermal comfort. We have to aim for a solution that will respond to all such issues."

Because the works to roof and front elevation were likely to increase the airtightness of the house substantially, it was decided to incorporate the MVHR system in the first phase. An airtightness measurement was carried out prior to the first phase works started, giving a result of 5.8 air changes per hour, at 50 Pascals of pressure. Once the first phase was completed the building was tested again, hitting a result of 2.4.

"It also made sense," says McCormack, "to install the relatively heavy and bulky equipment within the thermal envelope in the attic during the roof retrofit construction, when access was particularly easy and more worker support was available."

Because the machine faces the inside of an as-yet uninsulated external wall, some stripping away of this work is inevitable during the third phase in order to re-connect to the new attic gable wall fabric.

It is of course important that the house remain habitable throughout the three phases envisaged in the project, which is partly why most of the specified works are external.

"All the insulation is external," says Moreira, "so there's no mess inside the house. I know that sometimes interior works can't be ▸

avoided but if it is possible, external works should be the solution." Stripping back the roof from the outside allowed access to the rafters for the installation of both airtight membrane and insulation, obviating the need to come through the house. And as Moreira points out, installing the airtight membrane in this way made it easier to achieve airtight connections between roof and walls.

Staying with the roof, the design team ran into an unexpected issue which they believe is worth highlighting. The original roof build-up had envisaged full fill mineral wool between 175mm rafters, then the airtight layer above the rafters, topped off with 150mm rigid Rockwool boards.

"When we looked at it a bit more critically," says Art McCormack, "we discovered that during the winter time, there was a modest risk of condensation build up. The safer option was to reduce the amount of wool on the inside to 100mm, then to add another 50mm of rigid board to the outside, giving us 200mm on the outside, and only 100m on the inside."

The hygrothermal analysis which revealed this issue was carried out by Andrew Lundberg of passive house consultancy Passivate. The point, says McCormack, is to at least consider the hygrothermal risks in retrofit. "Don't just presume that it's ok to add loads of insulation inside the airtight layer in order to achieve a low U-value," he says.

While the project aims to secure Enerphit certification once completed, the Passive House Institute is currently introducing a new endorsement initiative designed specifically for step-by-step retrofits. It will soon be possible to get a step-by-step Enerphit plan certified by the Passive House Institute once the first step has been completed.

"Then," Moreira explains, "if you sell the house, the next owner will have that document, and he can continue to the second or third stage down the line. Then, at the end, when everything is done according to the standards criteria and step-by-step plan, the building can be certified."

The first stage of the project has delivered massive improvements, bringing the house's space heating demand down from 172.9 W/m²K to 55.2 W/m²K, eliminating the drafts and dramatically improving comfort levels in the house.

"The quality of air is incredible," says Mariana Moreira, "really amazing. I remember before, in the morning, you would feel the air very heavy from CO_2 produced by our own exhalation, you would have to open the windows to bring in fresh air, but you just don't need that anymore."

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

SELECTED PROJECT DETAILS

Architect & energy consultants: MosArt Architects
Client: Art McCormack
Main contractor: Michael Bennett & Sons
Energy consultant: MosArt Architects
Mechanical contractor: Ollie McPhillips Ltd
Airtightness consultant: Passive House Academy
Thermal breaks: Partel
External insulation: Parex Lanko, via Tradecraft
Roof insulation: Rockwool/Isover
Wall insulation: Kingspan
Airtightness products: Ecological Building Systems / Partel
Windows: Internorm
Roof windows: Velux
Ventilation system: Paul, via Ollie McPhillips Ltd

PROJECT OVERVIEW

Building type: 140 square detached 1960 family home. Enerphit step-by-step refurbishment. First step complete during 2015, including roof refurbishment, roof lights replacement, front wall refurbishment, front windows and glazed door replacement, heat recovery ventilation installed and balanced.

Location: Wicklow Town, Co Wicklow

Completion date: First phase 2015, second phase 2017/18.

Budget: €100,000 for phase one

Enerphit certification: Overall refurbishment plan to be certified

SPACE HEATING DEMAND
Before: 192 kWh/m²/yr
After: 48 kWh/m²/yr

HEAT LOAD
Before: 59 W/m²
After: 22 W/m²

PRIMARY ENERGY DEMAND (PHPP)
Before: 362: kWh/m²/yr
After: 120 kWh/m²/yr

ENERGY BILLS
Before: €3,000 on home heating gas and electricity (June 09-June 10)

After: N/A yet

AIRTIGHTNESS (AT 50 PASCALS)
Before: 5.8 air changes per hour
After: 2.4 air changes per hour

WALLS
Before: 215mm rendered concrete block walls internally insulated with 50 mm fiberglass. **U-value:** 1.153 W/m²K
After (north facade): 250mm Platinum EPS insulation and silica render finish externally fixed on existing 215mm rendered concrete block walls, internally insulated with 50 mm fibreglass. **U-value:** 0.106 W/m²K

ROOF
Before: Roof insulated on the flat: Existing 175mm timber joists (44mm at 400 centres) insulated with 175 mm fibreglass. **U-value:** 0.264 W/m²K
Roof insulated on the slope: Existing 175mm timber rafters (44mm at 400 centres) insulated with fibreglass. Sealed 22 mm air gap between plasterboard and timber rafters. **U-value:** 0.250 W/m²K
After: Roof insulation only on the slope (warm attic now part of the thermal envelope where the heat recovery ventilation is installed and first floor air ducting network is located). 100 mm mineral wool between existing 175 mm rafters (44mm at 400 centres), Pro Clima Intello airtight membrane above existing rafters, 150mm + 50 mm Rockwool insulation outside existing rafters and airtight membrane, Pro Clima Solitex Plus membrane over Rockwool insulation. **U-value:** 0.125 W/m²K

WINDOWS & DOORS
Before: double-glazed, timber windows and doors. **Overall approximate U-value installed:** 3.02 W/m²K
New triple-glazed windows (to north façade): Internorm triple-glazed timber aluclad windows and doors. **Overall U-value installed:** 0.87 W/m²K

ROOF WINDOWS
Before: Double-glazed timber frame velux windows installed in 1990s. **Overall approximate U-value installed:** 3.02 W/m²K
After: Three plus two panes of glass with PVC frame, passive house certified Velux windows. **Overall U-value installed:** 0.70 W/m²K

HEATING SYSTEM
Before: Viessmann condensing gas boiler (efficiency over 90%). Evacuated tube solar thermal collector.
After: Same.

VENTILATION
Before: No ventilation system. Reliant on infiltration, chimney, wall vents (generally blocked) and opening of windows for air changes.
After: Paul 300 heat recovery ventilation system — Passive House Institute certified to have effective heat recovery efficiency of 91.8%

"If you live in a temperate climate like the UK or Ireland, the idea of going to the Middle East and living in 40C heat for a few weeks might sound like hell. But after a few days there, your body starts to adapt."

Adaptive comfort

Should it affect building design?

The passive house standard delivers buildings that are capable of maintaining constant even temperatures throughout the building. But there is a long-standing school of thought that as people can adapt to different temperatures, building design should take this into account. But does this view stack up?

Words: Lenny Antonelli

"I wouldn't overestimate the effect of cleavage," building physicist Joost van Hoof told the New York Times last year, "but it's there." It's not often you read about cleavage in an article on thermal comfort (a term basically meaning how happy we are, or aren't, with the temperature of our environment).

"The cleavage is closer to the core of the body, so the temperature difference between the air temperature and the body temperature there is higher when it's cold," he said. Van Hoof was making the point that while men may still wear suits and ties to the office in summer (shorts are often banned), women are more likely to wear cooler clothing. So a woman may lose heat faster, making her feel colder.

He was commenting on research, published in the journal Nature Climate Change which found that temperatures in air-conditioned offices are more suited to men than women. In the paper, titled 'The Great Arctic Office Conspiracy', biologists Boris Kingma and Wouter van Marken Lichtenbelt argue that the classic thermal comfort equation developed in the 1960s and 70s by the scientist PO Fanger — and still widely used in the design of buildings today — leaves women colder because it's based on a

Photos: Dennis Schroeder/ Adam Johnson | Brockit Inc./ (c) Imageegami | Dreamstime.com

resting metabolic rate of a 40 year old man weighing 154 pounds.

For their experiment, Kingma and van Marken Lichtenbelt put 16 women inside a respiration chamber, and tracked how much oxygen they inhaled, how much CO_2 they exhaled, as well as their skin and core temperatures. They found the average woman's resting metabolic rate was up to 32% lower than the figures used by Fanger.

Fanger is the grandfather of thermal comfort research. His model predicts what percentage of a building's occupants will be comfortable, by taking into account six key factors: air temperature, mean radiant temperature (the temperature of all the surfaces that surround you), air velocity, relative humidity, the insulation value of your clothing, and the aforementioned — and now slightly controversial — metabolic rate.

As part of his methodical experiments in the late 1960s at the Technical University of Denmark, Fanger put his subjects into a climate controlled chamber. They all wore t-shirts — tucked out — cotton pants, cotton underwear, wool socks, and no shoes. He carefully measured the air temperature, humidity, radiant temperature and the air speed in the chamber. He kept lighting and noise levels content. He asked his subjects about their diet, sleep and menstruation, to control for all possible explanations for thermal comfort.

The participants were allowed to drink, but not eat, but Fanger measured how much liquid they drank, and how much weight they lost due to evaporation over the three hours (evaporation from the skin is a key component of thermal comfort). Once inside, the subjects were only allowed to talk or read quietly. They weren't allowed to talk about how comfortable they felt, so as not to bias the study. But he also got them to perform different activities, to increase

their metabolic rate, and in some of his experiments, he gave his subjects control over the temperature inside the chamber, and asked them to adjust it until they felt comfortable.

Every half hour, Fanger asked his participants to rate their level of thermal comfort on a scale from minus three (cold) through to three (hot). This was Fanger's simple but revolutionary leap in the field of thermal comfort — asking his subjects to rate their own perception of comfort.

The tool Fanger developed, the 'predicted percentage dissatisfied' index' (PPD) is still widely used by building engineers, and it says that for optimum comfort less than 10% of building occupants should be dissatisfied (getting under 5% is considered impossible). You can find plenty of widgets online that allow you to adjust all six key comfort factors up or down, and see how many occupants in your hypothetical building become unhappy.

Even though it's been used to design buildings for decades, Fanger's work has its detractors — and not just those who say it's gender-biased. Proponents of what's known as the 'adaptive comfort model' argue that Fanger's model places too much emphasis on maintaining a narrow range of conditions, and ignores our ability to adapt to different climates.

If you live in a temperate climate like the UK or Ireland, the idea of going to the Middle East and living in 40C heat for a few weeks might sound like hell. But after a few days there, your body starts to adapt. Adaptive comfort enthusiasts want to apply this principle to building design. They say we don't actually need to control building temperatures so tightly — we can allow for more flexibility, and use less energy intensive heating and cooling systems to control indoor climate. We are not passive recipients of our thermal environment, the thinking goes, but play an active role in adapting to it.

Human beings adapt to changes in climate in three ways. First, behaviourally: if we feel cold we might close the window, turn off a fan or close a window; equally, taking a siesta in a hot climate is behavioural adaption.

We also adapt our physiologies. Over generations, the genetics of an entire race can evolve to suit a changing climate, by making us predisposed to keep body fat in a cold climate, for instance. On a shorter time scale, our body's thermoregulatory system can help us adjust to very hot climates within a few days. Adjusting to the cold takes longer, though.

Finally, we adapt our psychology: by shifting our expectations of comfort, we can be happy at a wider range of temperatures. Research has shown that in naturally ventilated buildings, we expect indoor temperatures to follow those outside, and that we relax our expectations in response.

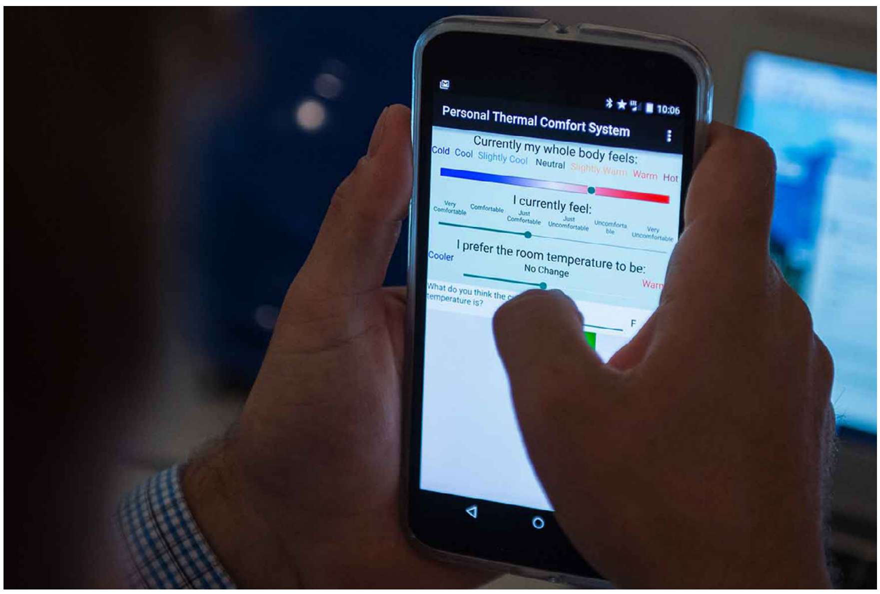
In buildings with tightly controlled indoor climates, however, we become more demanding. Proponents of adaptive comfort say this can be a viscous circle: we get used to a narrow range of comfort, demand more control and tighter conditions, feel uncomfortable in temperatures we previously would have happily adapted to, and start to feel ever more fussy about what we'll tolerate.

Perhaps the zenith of the adaptive school of thought is the idea of 'thermal delight' — that idea that experiencing a variety of temperatures makes us feel more alive, like jumping into a cool ocean on a hot day, so we should design varying thermal 'textures' into our buildings.

In her 1979 book Thermal Delight in Architecture, the engineer and architect Lisa Heschong compared the richness of our thermal environment to the richness of food, and said it has "the potential for such sensuality, cultural roles, and symbolism". Her basic idea? That there is a simple pleasure to be had from exercising our thermal senses. Some proponents of 'thermal delight' even say we should use fans to vary temperature and air flow in buildings, and awaken our senses.

"The building industry needs a fundamental paradigm shift in its notion of comfort," Gail Brager, Hui Zhang and Edward Arens from the University of California's Centre for the Built Environment wrote in a paper published last year, "to find low-energy ways of creating more thermally dynamic and non-uniform environments that bring inhabitants pleasure."

(below) Scott Jensen and Grace Brown, the first volunteers to take part in testing in the US National Renewable Energy Laboratory's Comfort Suite (C-Suite), an experimental environmental chamber designed to reveal the connection between human comfort and energy systems; (left) PO Fanger, the grandfather of thermal comfort research; (p79) thermal manikins are commonly used for scientific testing of thermal environments without the risk or inaccuracies inherent in human subject testing



Some adaptavists have criticised the passive house standard too, by arguing that it seeks to maintain too narrow a range of indoor temperatures. "Passive house tends to work against the idea of adaptive comfort because it aims for an optimised temperature range that does not necessarily reflect the wider range that people are able to adapt to," says Fionn Stephenson, professor of architecture at the University of Sheffield. Stephenson also says passive house occupants tend to be overly sensitised to drafts in other buildings.

In a paper published last year, Kate Carter and Jing Zhao of the architecture department at the University of Edinburgh wrote that: "In order not to 'live a life in a jumper', potential clients are attracted to the Passivhaus system for its narrow-ranged comfort zone, and the lived experience of Passivhaus has in turn narrowed it [sic] for its residents an expectation of thermal constancy, pushing the indoor environment further away from adaptive comfort."

But critics of adaptive comfort say it's just a fancy term for the old 'hairshirt' concept of sucking it up, putting on a jumper and braving the cold, which is a hard sell to all but the most committed environmentalists. And speaking to Passive House Plus, various passive house experts were dismissive of the idea.

First, they pointed out that passive house buildings have stable indoor temperatures because they are very well insulated, not because they are mechanically controlled. The passive house standard doesn't, in fact, insist on keeping indoor temperatures within a narrow range. Occupants are free to turn their thermostats up or down. If you don't use the heating or ventilation in your passive house, the temperature inside will track outdoor temperatures, albeit less extremely than in a poorly insulated building.

"In winter, if you want, then you can turn the heating up. If you want it cooler then it can be turned down," leading passive house architect Mark Siddall wrote in a paper on adaptive comfort. "If you want to wear more or less clothing then that's entirely up to you. You can also open the windows whenever you choose – even in the winter."

"Central heating systems are in the vast majority of homes," Siddall told Passive House Plus. "Why are they so pervasive? People want to be warm and fuel is at its most accessible in the entire history of civilisation. Encouraging people to tolerate discomfort for the good of the world is a hard sell. Much harder than letting them choose the comfort and temperatures they want whilst minimising fuel use through adopting well considered performance standards like passive house."

Passive house engineers also point out that building to the passive house standard means less mechanical heating and cooling, less need for complicated controls — in other words, a more free-running, natural building.

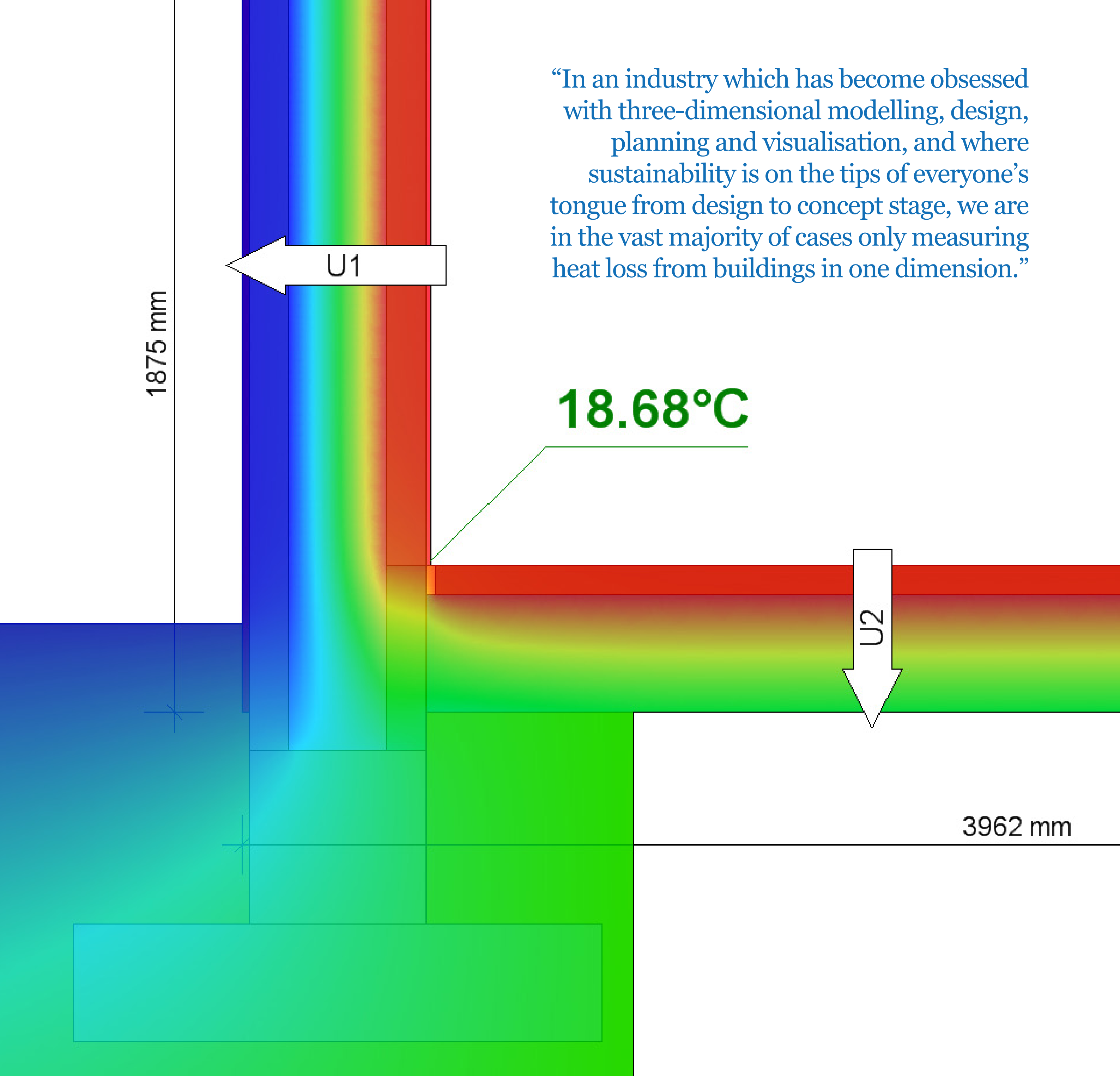
Critics of adaptive comfort also argue that the theory doesn't stack up as well with cold temperatures, otherwise those living in poorly insulated and drafty homes would have adapted happily to them.

"Monitoring of passive house projects shows that in fact people simply like to live in warm, consistent temperatures. Given a house that is cheap and easy to heat, it turns out that people like to keep it around 20 C when it's cold out," says leading passive house heating engineer Alan Clarke.

But if it's possible to adjust the indoor environment in a passive house, by adjusting the heating and ventilation settings or opening windows, is the notion of a conflict between passive house and adaptive comfort a false dichotomy? And in an industry not known for its consideration of evidence – occupant feedback or measurable performance data – isn't there a risk that whatever its merits, theories such as adaptive comfort may be used to excuse the construction of uncomfortable buildings?

A fully referenced version of this article will be published on the Passive House Plus website.

"The passive house standard doesn't insist on keeping indoor temperatures within a narrow range. Occupants are free to turn their thermostats up or down. If you don't use the heating or ventilation in your passive house, the temperature inside will track outdoor temperatures."

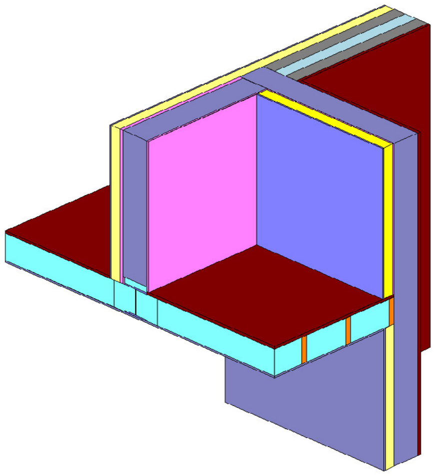


"In an industry which has become obsessed with three-dimensional modelling, design, planning and visualisation, and where sustainability is on the tips of everyone's tongue from design to concept stage, we are in the vast majority of cases only measuring heat loss from buildings in one dimension."

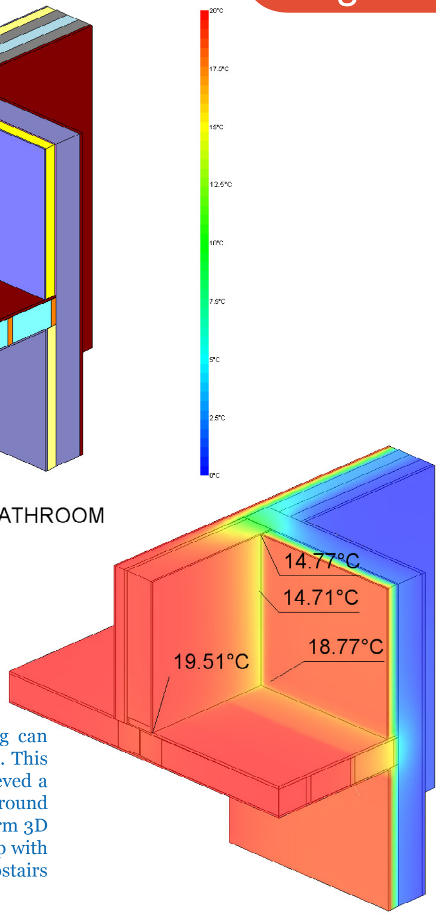
Thermal bridging:

risk & opportunity

Assessment of thermal bridges is the low hanging fruit lining the path to passive house and low-energy building, according to leading thermal modeller Andy Lundberg of Passivate, who says that taking the time to understand thermal bridging and to minimise and calculate it properly is essential to delivering cost optimal low energy buildings without an Achilles heel.



VIEW FROM 1ST FLOOR BATHROOM



(opposite) Good thermal bridging detailing can be done with conventional build approaches. This Zeno Winkens-designed passive house achieved a negative Psi-value of -0.028 W/(mK) at the ground floor wall junction. (above and right) Psi-therm 3D modelling of a Dublin retrofit which ended up with a line of mould in the kitchen ceiling and upstairs bathroom wall.

The importance of thermal bridge assessment has never been as prevalent as it is today, and it is about to become even more so with the onset of nZEB (nearly zero energy buildings) and imminent changes in Ireland to Part L for non-domestic buildings. And yet despite tougher building regs and a surge of interest in the passive house standard there hasn't been any significant palpable change in our knowledge as an industry in terms of what thermal bridging actually is, what the regulations require us to do when it comes to accounting for thermal bridging in buildings, how we minimise thermal bridging effects at design stage, where it sits in the overall context of a BER or Sap assessment and so on. Thermal bridging is a known unknown that gets tossed around like a hot potato. No one can deny its existence and the fact that it can't be ignored, in fact most professionals involved in building design will attest to its importance, but nobody wants to be the one to do it. And for those who haven't crossed the threshold of taking an in-depth look into what thermal bridging is, there is a warm fluffy cushion for them to rest on, a place of sheer bliss for which a ticket can be purchased at the price of some extra insulation here and a heat pump there. This place is otherwise known as 'the default value hotel'. But little do most of the guests know that the hotel is about to enter administration.

So before we go on to talk about thermal bridging in the context of nZEB, passive house and Part L compliance, let's take a step back and look at thermal bridging for what it really is, where it comes from and what the numbers tell us. The first thing to know about thermal bridging is that it's nothing new. Early cave dwellers, who made excellent use of cliff-face orientation, thermal mass and form to create comfortable environments in all seasons, didn't crack the thermal bridging issue either. Considering however that we as a human race are now planning a manned mission to Mars, relatively speaking our progress in dealing with thermal bridging has moved at glacial speed by comparison. So what we do know is that all buildings suffer from the effects of thermal bridging, and that is completely unavoidable. What we can do through knowledge, good design and use of finite-element analysis, is reduce its effects insofar as reasonably practicable, sensible and affordable.

When it comes to thermal bridge assessment, there are two things we want to look at. One is the additional heat loss attributed to the junction in question, and the second is the risk of any surface condensation – and related subsequent mould growth – occurring. In terms of measuring additional heat loss at junctions, this is important so that we can be sure that our buildings are only specified with the amount of insulation and quality of windows etc. that the building actually needs in order to comply with building regulations as well as ensure occupants have an optimal living environment, without unnecessarily forcing self-builders, contractors or developers to put in more than is necessary, just to get green tick boxes in a Deap or Sap compliance check. The same applies to passive house design and PHPP, but the way passive house design is assessed has a high degree of built-in safety when it comes to the inclusion of heat loss from thermal bridges.

It's common knowledge that investment in insulation is a no-brainer for poorly insulated buildings, but that the returns on investment diminish greatly with every additional millimetre installed above a certain level specific to each building. This was a core aspect of the development of passive house back in 1995, and the recast Energy Performance of Buildings Directive also now requires us to build in a cost-optimal way. So only spend what you need to spend in order to create an environment which is affordable to build, affordable to live in, comfortable and hygienic. In order to do that however, we need as much information as possible about what is getting input to the building design. Absolutely detrimental to that goal is the use of default performance values. What may seem like a quick and easy way out of a knowledge-gap issue may inevitably hit you square in the pocket, and that is completely avoidable.

When measuring overall building fabric heat loss, we are all extremely comfortable with the term U-value as well as the concept of what it is, right? I know this because in a recent casual poll of 40 building design professionals, I asked if everyone knew what a U-value is, and they all raised their hands. When I asked if they could readily calculate one, given the right information, less than half kept their hands up. Asked if they could accurately describe the concept to an unknowing stranger, we were down to 12. The elephant in the room there was the fact that there were people who were happy to calculate something that they then couldn't really describe to a stranger. There is a wider issue there! When further probed about what the units of a U-value were, we were down to eight. And when asked if they could describe well what those units represented and how they were arrived at by calculation, we were down to two. So maybe we're not as comfortable with the heat loss calculation and U-value concept as we thought. And we'd do a whole lot better to just admit that and start doing something about it.

What a U-value does tell us is how much heat energy in Watts is being lost across a given square metre area of a building element, for every one-degree temperature difference between the heated internal space and the outside world. The relationships are linear, so if you double the area of a building element, you double the heat loss. Similarly, if you double the temperature difference you also double the heat loss. The U-value is mainly dependent on the thickness of materials used to build the element, and their thermal conductivity. The thermal conductivity is measured in Watts per metre and Kelvin, where the 'metre' describes the heat loss across the thickness of the material from inside to outside, and Kelvin describes the temperature difference between the inside and outside. The incremental difference between 1C and 2C and 1 Kelvin and 2 Kelvin is exactly the same, it's just that Celsius is used to describe a temperature, and Kelvin is used to describe a temperature difference.

So when it comes to how good an insulator is at resisting heat loss, the thermal resistance will increase with either increasing material thickness or decreasing thermal conductivity. The overall U-value is calculated by adding the total thermal resistance of all layers in an element, as well as a small amount of resistance provided by a thin air layer which is bound to the surfaces of the element, and inverting them. That's why high thermal resistance is accompanied by a low U-value. The higher the resistance gets, the lower the transmittance, or U-value becomes. As mentioned at the top of the paragraph, its units of measurement are W/m²K. The m² describes the area of the element in question, with the heat loss occurring perfectly perpendicular to the surface of said element. However, ultimately, the U-value is dependent on values of thermal conductivity (or equivalent thermal conductivity for air cavities, in which radiation transfer is the predominant mechanism of heat transfer), which are measured in only one direction, based on thickness. And so in an industry which has become obsessed with three-dimensional modelling, design, planning and visualisation, and where sustainability is on the tips of everyone's tongue from design to concept stage (either because it's good for marketing or just the right thing to do), we are in the vast majority of cases only measuring heat loss from buildings in one dimension. It would be embarrassing only for the fact that almost no one has taken that fact on board. There is great comfort in numbers.

The other two dimensions of heat loss, ie heat loss which can't be described by a U-value, are measured by carrying out thermal bridge assessment. Heat loss in the second dimension is linear heat loss, and is described by psi-values. If a U-value has units of W/m²K and describes heat loss across an area, then linear heat loss described by psi-values must have units of W/mK. This psi-value describes the heat loss linearly between two elements, such as where a wall meets a floor or a roof, or at the line of where a window meets a jamb, lintel or sill, for example. It's calculated by building a thermal model of the junction in question in 2D and determining the additional heat loss where the two elements meets.

Similarly, additional heat loss in the third dimension is described by chi-values. These describe single point penetrations of the building fabric, such as a steel column penetrating a floor slab down to foundation, or even a simple cavity wall tie. They can also represent the additional heat loss at the point where three or more planar elements come together, such as at the base of an external wall corner junction with the floor. Because these singular points don't have an area of length that can be measured, their units are simply Watts per Kelvin heat loss, or W/K. So each of U-values, psi-values and chi-values all describe heat loss in Watts, dependent on temperature difference across an element, but the differentiator between them is whether they describe the heat loss across a square metre of a single element, the linear length of the junction between two elements, or just the dimensionless penetration of an element.

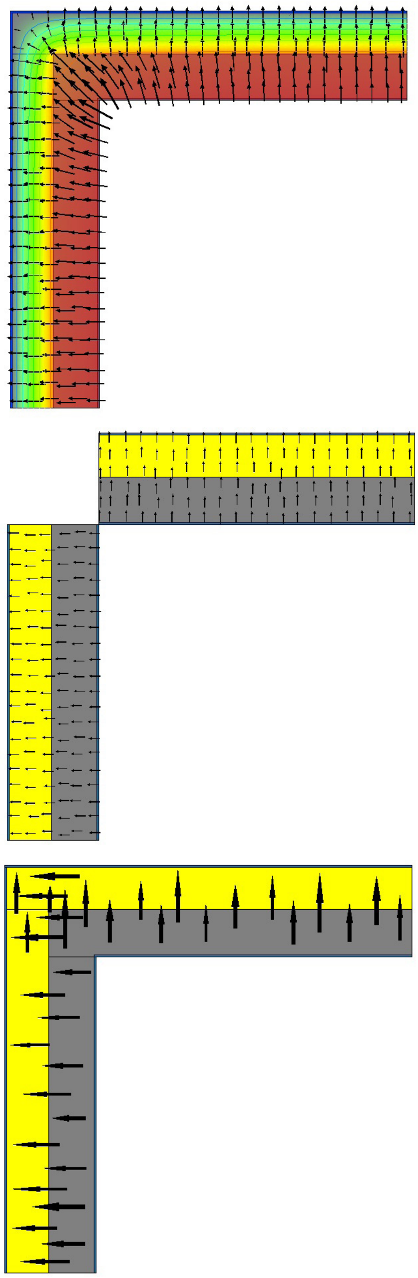
But what actually determines the psi-value or chi-value – what is it dependent on? What might seem the first and most obvious thing is the way the junction is put together and what materials are used in its construction, and that certainly plays an enormous role. When it comes to a first pass look at thermal bridging in a building, a simple exercise to carry out is to take construction drawings in plan and section, and place a pencil at any point on the primary insulation layer. Then run the pencil around the building perimeter. You shouldn't have to lift the pencil to get from the primary insulation layer in one element to the primary insulation layer in the next. If you do, then you most likely have a thermal bridging issue, in most cases caused by a structural element, that you will need to deal with. It's no guarantee that the junction is going to cause an issue in terms of additional heat loss or mould growth risk, but it's certainly something that absolutely needs to be looked at before proceeding any further.

The good news is that there are some very novel products coming onto the market all the time which can deal with these problem spots. These include aerated concrete blocks, high-density and bearing strength EPS which can dramatically improve heat loss around window junctions, recycled glass which resists both heat and vapour transfer, and polyamide/nylon plates for steel-to-steel connections and steel-to-concrete connections, among many others. The key is to use the right thing in the right place, and that requires knowing where the problem is and why it's occurring, and having the product knowledge to be able to select the right product for the job.

The most obvious contributor to the magnitude of a psi-value is the way we actually measure our buildings for the purpose of Sap, Deap or PHPP calculations. However, in terms of what determines the psi-value it is equally, if not even more influential than the components used to assemble the junction in the first place. If we take the example of Sap or Deap calculations, in accordance with convention the building is measured internally. As we discussed earlier, when we describe heat loss using U-values, we only describe heat loss at a right-angle to the surface of interest. So by measuring the building internally, when we come to any outward-facing junction, such as an eaves, ground floor/wall junction, external wall corner etc. there is essentially a hole in our calculations, as we're limited to a one-dimensional heat loss calculation, and our U-values are blind to the heat loss happening in the second dimension at the junction. So the psi-value accounts for that shortfall.

To put it simply, if we imagine having two wicker baskets which represent the U-values of two walls either side of a junction, each with five apples in them, then adding up the total we would say there are ten apples. But if we model that junction in 2D thermal analysis software, and the result is that there are actually twelve apples, then we know that there must be two apples outside the wicker baskets. These represent the additional heat flow at the junction, which couldn't be seen by only counting what was in the baskets. It might sound incredibly simple, but that is literally what thermal bridge assessment at its core is doing. What we also see is that typically, by measuring buildings internally for heat energy balance calculations, we are underestimating the amount of calculable heat loss from a building.

Conversely, in passive house, as well as national conventions in many countries, fabric heat loss is calculated by measuring the building externally. Going back to our apple analogy, this is akin to measuring the five apples in the first basket and including two apples from the second. So you come up with a figure of seven apples in the first basket. Repeat this for the second basket, and you now end up thinking you have a total of fourteen apples. But we know that in reality there is still a total of twelve apples, so we've over-counted by two, as those apples were common to both baskets. So to accurately account for the total number of apples, we need to subtract two apples from our calculations. And hence we end up with the concept of a negative psi-value which passive house is famous for. However, it's not necessarily because a particular junction is exceptionally well designed, but to a large extent because it was measured externally, ie over-estimating heat loss in one-dimension, and therefore having to subtract some heat back to get an accurate figure.



(top to bottom) How heat loss flows through two connected walls, as simulated by Psi-Therm; That same junction as treated by PHPP; and by Deap/Sap. Note that PHPP overestimates the heat loss, while Deap and Sap underestimate it


Hi-therm™
LINTELS
Remarkably advanced
Hi-therm, the single most cost efficient solution for lowering carbon emissions within SAP.
WINNER
BEST BUILDING FABRIC PRODUCT 2013 & 2014
NATIONAL HOUSEBUILDER AWARDS

There are a lot of myths surrounding the passive house standard and what it really takes to achieve it. One of the most common ones is that you can't open the windows in a passive house. That question gets dealt with at every passive house conference and seminar. There is also the concept that a certified passive house must have psi-values of 0.01w/mK or less at every junction. That is not the case. For example, in a certified passive house, if the installation of a window is graphically shown to be thermally robust, then it's not always a requirement to calculate the psi-values for the installed window. The default value then used is 0.04W/mK in PHPP. This is fairly punitive, as a typical passive house window installation loses about half that much heat, so it's in one's interests to get those analysed to save having to compensate for them elsewhere. What is true is that to certify an opaque building element — such as a wall system — as a passive house component, the manufacturer does have to come up with standard connection details which have psi-values of 0.01W/mK or less. So you do need to have these psi-values to certify a building system, but you don't need to have them to certify a building using a non-certified, standard construction system. It's crucial to know the difference, as these misconceptions are commonly what prevent people from deciding to go down the passive house route in the first place. Indeed, one of the beauties of the passive house concept is that it doesn't matter how you build it as long as it reaches the target values, and it doesn't matter how you heat it either as you need so little (national building regulations always apply regardless, and compliance here is heavily influenced by heating fuel type and plant). So the pressure is off. Buildings can be built to the passive house standard and certified with psi-values above 0.01W/mK.

Returning to the wicker basket example, when calculating heat loss in passive house buildings, we are typically over-estimating heat loss by measuring externally. So if we actually calculate the psi-values for junctions in a passive house they're typically negative values, in order to correct for our conservative over-estimation when doing our energy-accountancy. In this instance, every negative psi-value entered into PHPP reduces the calculated annual heat demand and heat load. In fact, on a number of passive house projects I've worked on, a house which has a calculated annual heat demand of 15kWh/m^{2}yr initially, will reduce to circa 12-13kWh/m^{2}yr once thermal bridges are entered. So calculating thermal bridges now means that you have 2-3kWh/myr to play with in terms of savings in specification items elsewhere. It's important that we use that, as the 15kWh/m^{2}yr target value is not arbitrary, but rather the cost-optimal energy performance value around which the passive house concept is based. Going significantly below this value could well be viewed as wasting money.

The same applies, but to an even greater extent, in the determination of Part L compliance using Sap or Deap. Whereby PHPP allows for individual entries of psi-values, on a need-to-input basis normally, the Deap software only has one single value entry cell for thermal bridging, termed the Y-factor. This is another value around which there are some misconceptions. The Y-factor is not a percentage. It is not a weighting factor. It is also neither a correction factor nor a multiplier.

The Y-factor is a number calculated using the individual psi-values of all the key junctions in the building. The value is area-weighted over the area of the exposed building fabric, so it describes as a whole the amount of heat energy loss (due to thermal bridging) over each square metre area of the building fabric for every one-degree temperature difference between inside and outside. So the units for the Y-factor are W/m^{2}K, which are the same units as those of a U-value. And they can be directly compared. This is also where things start to get scary.

I'll deal with the Irish situation first, before describing the UK situation. When accounting for thermal bridging in a Deap calculation, we have four options to choose from in accordance with TGD Part L (2011) of the Irish Building Regulations, which are as follows:

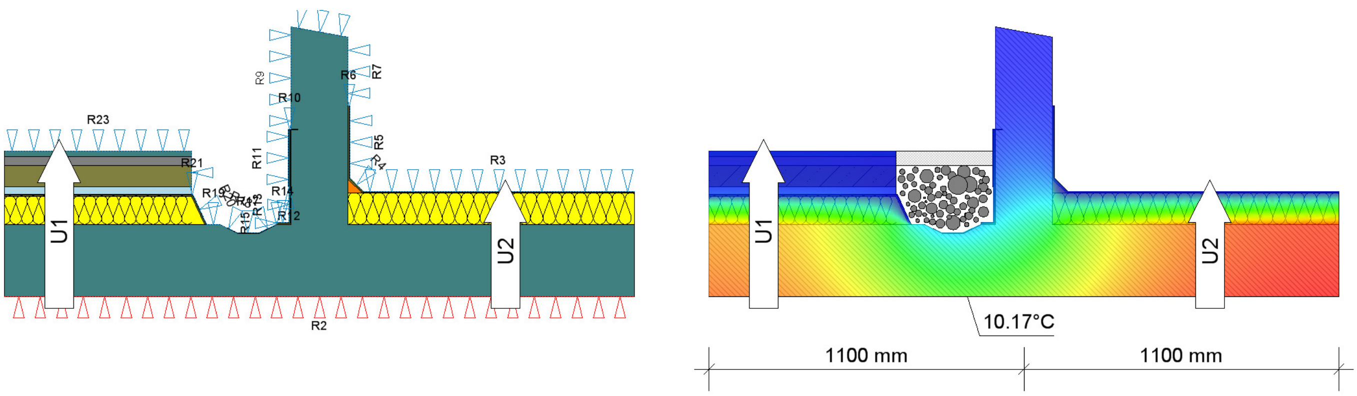
1. **Build in accordance with the Acceptable Construction Details and use a y-value of 0.08W/m^{2}K.**
2. **Build in accordance with a bespoke construction method and use psi-values calculated by an accredited member of the NSAI Thermal Modellers Scheme or other equivalent accreditation scheme to determine the y-value.**
3. **Build using a blend of both, and use a combination of the values provided by an NSAI-accredited modeller (or similar) and the values from Tables D1-D6 in TGD Part L (2011) to determine the y-value.**
4. **Do not determine any individual psi-values and simply input a y-value of 0.15W/m^{2}K.**

The method used in point one is the commonly applied method in Ireland. In a study of building energy ratings submitted in Co Dublin for new-build housing from 2005 to present day between 75 – 174m^2, 62% used a 0.08W/m^{2}K y-value for thermal bridging. This is effectively a statement that all key junctions in these buildings were built in accordance with the Acceptable Construction Details, and without a single key junction deviating from that. If a house has an average area-weighted U-value for all elements of 0.16W/m^{2}K, for example, this would mean that 33% of fabric transmission heat loss is due to thermal bridging. This is in most cases a gross over-estimation. In order to demonstrate compliance with Part L, this apparently poor fabric performance due to thermal bridging will need to be compensated for elsewhere, be it via investment in thicker insulation in another part of the fabric, or investment in renewable energy plant, for example. Either way, money will need to be spent unnecessarily. In most cases, it's more cost-effective to calculate the bespoke y-value for a building, than to use the 0.08W/m^{2}K y-value and invest in other measures to compensate.

The method used in point one allows for a combination of sources of details including the Acceptable Construction Details. The majority of these details, and their related psi-values published in Appendix D of TGD L (2011), are not optimised details and therefore may not offer the best details in terms of reducing heat loss at junctions as well as reducing mould growth risk to its lowest possible level.

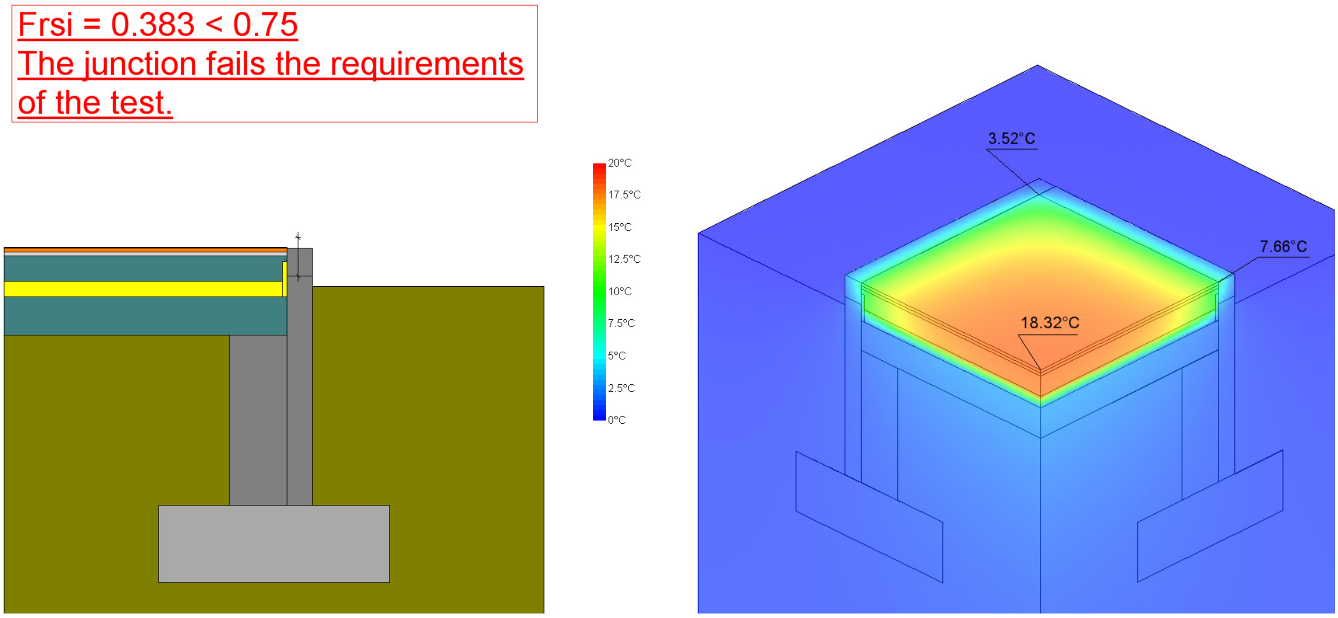
The method used in point four of not calculating any specific psi-values but instead using a 0.15W/m^{2}K default value is a high-risk strategy. Again using the average U-value of 0.16W/m^{2}K for a given house, assigning a y-value of 0.15W/m^{2}K means that the Deap calculation estimates that 48% of fabric transmission heat loss is from thermal bridging. That is a ridiculous concept for most standard houses. Compared to using the value in point one of 0.08W/m^{2}K, the amount of additional investment to compensate for this simply in order to demonstrate compliance with Part L in a Deap calculation has increased by an order of magnitude – more unnecessary waste which is completely out of tune with the fabric-first sustainable building approach as well as cost-optimal considerations. We shouldn't forget that the Energy Performance Coefficient, or EPC, in Deap calculations is

A detail of an upstand on an in-situ cast building. The insulation stops short of the upstand and has a drainage channel, as well as the upstand itself not being insulated. The ceiling below has a circa one metre wide band of mould for its entire length




Efficient thermal insulation.
For concrete parapets.
The Schöck Isokorb® type AXT offers a cost-effective and more thermally efficient alternative to wrapped parapets. Thus makes sure that no additional thermal bridges are created by fastening elements or railings. And gives you more scope for design – for narrow parapets, architectural concrete on the inside, and larger terrace areas.
Schöck Isokorb®
Schöck Ltd | Staniford House | 4 Wedgwood Road | Bicester | Oxfordshire | OX26 4UL | www.schoeck.co.uk/parapet


Tp TECHNOpor®
GLASS FOAM GRANULATE
100% Recycled glass
The perfect sub floor solution
STRUCTURAL - THERMAL - LOAD BEARING SUB FLOOR
Lambda - 0.8W/m²K - Compressive strength - 0.5N/mm²
Bulk density - 170kg/m³ - LABC approved
UK sales: Ecomerchant
T: 01793 847 444
info@ecomerchant.co.uk
www.ecomerchant.co.uk



This is a kitchen extension built in 2010. The fRsi requirement in building regulations is still 0.75 at the linear junction and 0.7 at the point corner. This kitchen was suffering from massive condensation at the glazing base, as well as differential expansion due to moisture causing tile cracking. As you can see, the frame sits on the outer leaf block which runs all the way up from the strip. Perimeter insulation was installed but due to poor levelling, the screed over-ran it considerably at the top so it was rendered quite useless. Once tile adhesive and tile went on, a very poor junction was presented

based on a building of equal size to the one in question, albeit using standard reference performance values. The value used by the Deap software for thermal bridging is 0.11W/m²K. Any number below that entered means you are essentially winning the compliance numbers game, and any above and you are seriously on the back foot. There is one final caveat with the use of the default 0.15W/m²K y-value. By entering this value, the responsible professional is essentially stating, as outlined in TGD Part L (2011), that all the junctions in the building are free from mould growth and surface condensation risk. This implies that either the junctions were assessed using numerical analysis (highly unlikely) or that the responsible professional has the experience to determine visually that no mould growth or surface condensation risk is present. In the current climate and days of BCAR (Building Control (Amendment) Regulations), that is a very onerous approach to take. In the study of BER calculations described earlier, 13.5% had used this value.

The method used in point two is the only method which allows the freedom of the user to strive for low thermal bridging values. There are a number of professionals offering the service on the NSAI Thermal Modellers Scheme, as well as a growing number of product manufacturers producing catalogues of thermal bridging values specific to their systems and products. In a recent study I carried out using such a catalogue of optimised junctions, the actual calculated y-value for a standard three-bedroom semi-detached house was just 0.022W/m²K. This represents just 12% of total fabric transmission heat loss, where an average U-value of 0.16W/m²K is used, and can be achieved readily using optimised yet standard construction systems. In the study of BERs mentioned earlier, just 15.5% of submissions availed of this option, however to put that in real figures, there were only 20 discernible y-values, as the majority of submissions in that category used the same y-value on multiple houses in developments. So all in all, the number of design professionals choosing to calculate the bespoke y-value for a given project is miniscule. These are the projects that are achieving the lowest-energy standard and cost-optimal designs. For the rest, there is a lot of catching up to do.

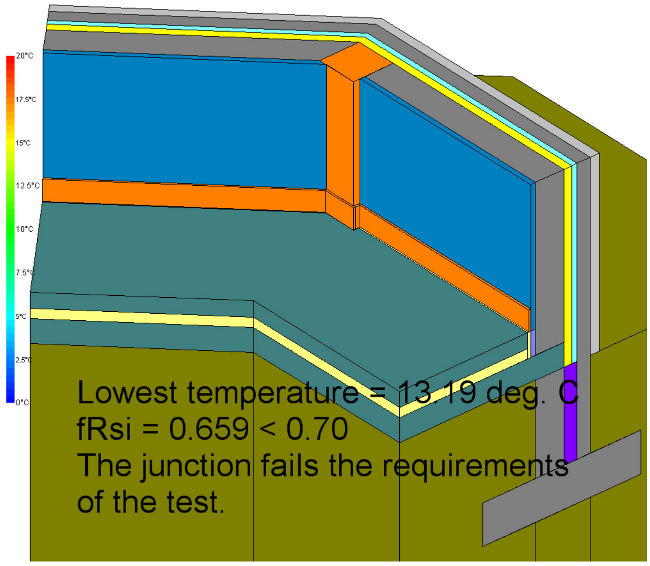
Interestingly, a further 9% used a value of 0.11W/m²K, which is the reference value used by the Deap software in determining the EPC value. However, this value is not and never has been quoted in any TGD Part L document as being an input value for thermal bridging in a Deap calculation. Offering the benefit of the doubt, this too could be a bespoke calculated y-value which coincidentally matches the reference value.

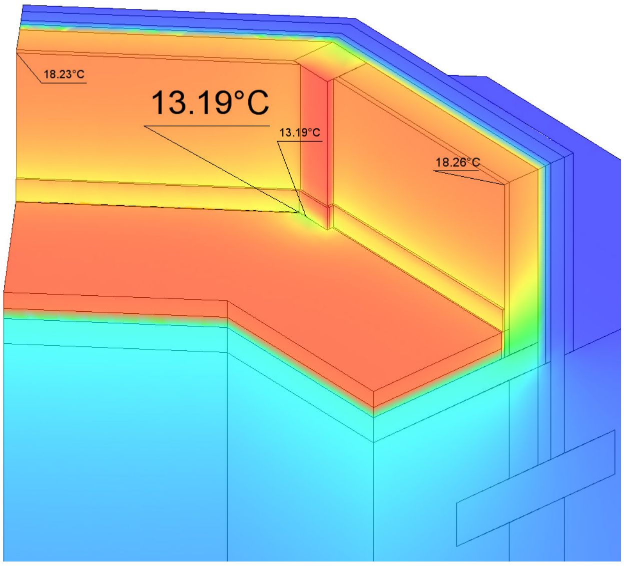
The situations in the UK (England, Northern Ireland, Scotland and Wales all have separate building regulations) and Ireland regarding how thermal bridging needs to be accounted for in a Sap or Deap calculation are very similar, however the differences are important. Under the various UK regulations (both English and Welsh Part L1a, Scottish Section 6, and Northern Irish Part F) where a building is constructed in accordance with the Accredited Construction Details (which differ in Scotland) the psi-values for each junction are taken from table K1 of the Sap document. However, this table is extremely limited in the information it provides. Firstly, there no distinction between any ranges of U-values for elements flanking the junction. The reality however is that the psi-value is heavily influenced by the U-values of the elements either side of the junction. Secondly, the values are not specific to any construction type, even though the differences in psi-values for the same junction, between externally-insulated masonry, full-fill cavity wall and partial-fill cavity wall with internal insulation, can be very significant. The same is true for all construction types.

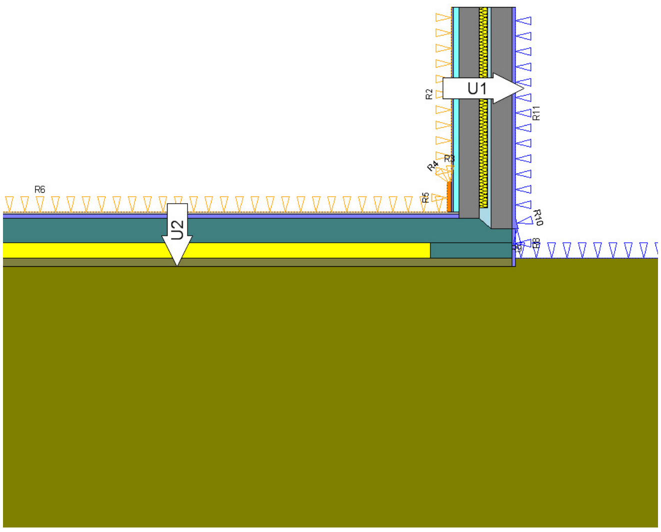
Where a junction is not built in accordance with the Accredited Construction Details (England, Wales & N Ireland), the applicable approved psi-value cannot be taken from table K1 of the Sap document, but is rather taken from the default column of table K1. These values are in almost all cases exactly double the approved value. So we have an unfortunate case in which neither the approved values nor the default values in any way accurately describe heat losses from thermal bridging for a given project, unless by absolute and highly unlikely coincidence. This fact is made even more disappointing by the fact that compliance with Part L1a demonstrated by a Sap calculation requires a target fabric energy efficiency (FEE) value to be achieved, meaning that a fabric-first approach is required. Sap assessors are therefore very in tune with the idea that decreasing heat loss from thermal bridges is essential in achieving compliance.

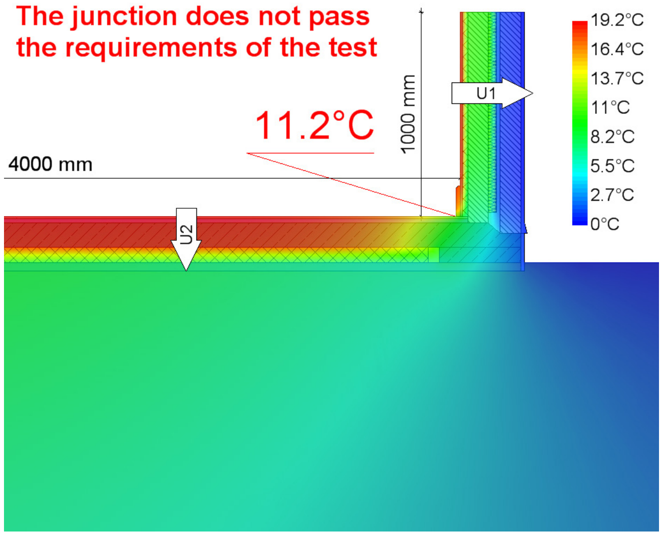
Common to all jurisdictions is that psi-values can be obtained from a competent assessor. Under Part L1a, a competent assessor is someone who has received training in thermal bridge assessment and completed a series of validation cases from the document 'BR 497: Conventions for calculating linear thermal transmittance and temperature factors (BRE Press, 2007)', and obtained values within stated tolerances. Competence is therefore self-certified, and the enforcement of this requires the party commissioning the assessments to know to ask this question of the assessor.

In Ireland, assessors who wish to provide calculated bespoke psi-values for the purpose of input to a BER/Deap calculation must be members of the NSAI Accredited Thermal Modellers Scheme, or similar approved, as outlined in TGD Part L (2011). Entry to this scheme is via two paths, with one being the submission of a portfolio of work and completion of further assessment by the NSAI, and the second being by successful completion of a one-semester course in thermal bridge assessment at Dublin Institute of Technology, which I deliver. Uptake on the scheme has been slow, which may be in no small part due to the lack of perceived importance of thermal bridging as a means to reduce unnecessary design and build expense, due to the fact that Part L compliance in Ireland doesn't require a fabric-first approach beyond achieving back-stop U-values and









(above) This appalling detail is a kitchen extension that was built straight off the top of patio slabs without foundation – by a contractor. It was shuttered to form a thin raft and then had cavity wall and screed built over it. Total continuity of concrete from inside to outside; (top) The corner of this conservatory wall failed to meet the fRSI requirement at the wall to floor corner junction due to a steel element beneath a softwood post in the build-up at that point

making up the rest of the numbers with bolt-on renewable technologies.

It would seem that all the aforementioned countries have a thing or two to learn from each other when it comes to ensuring competency of assessors in the public interest, government-body provision of thermal bridging values specific to construction types and U-values, and implementing a fabric-first approach to regulatory compliance.

Given our current obligations under the Energy Performance of Buildings Directive, coupled with the introduction of nZEB for all public buildings in 2018 followed by all new buildings in 2020, it will be increasingly difficult to demonstrate compliance with each relevant standard via the use of default thermal bridging values. Given that in Ireland the current required MPEPC (maximum permitted energy performance coefficient) for Part L compliance is 0.4 (representing a 60% improvement on 2005 values), the nZEB standard requires an MPEPC of 0.302 be achieved. Optimisation of junction design, coupled with bespoke calculation of the related y-value, can go a long way toward achieving this value alone without any further measures. It is without doubt a fact that there are a number of dwellings being built at present which are already nZEB-standard, disguised as standard Part L compliant buildings, purely because of the use of a default y-value in their BER calculation. They are not getting credit where credit is due. Associated with each of those is a real monetary value for the additional measures which were implemented in order to compensate for this. We don't need to be cherry picking expensive solutions when the reality is that assessment of thermal bridges is the low hanging fruit lining the path to nZEB, passive house and low-energy building.

> "The 15kWh/m²yr target value is not arbitrary, but rather the cost-optimal energy performance value around which the passive house concept is based. Going significantly below this value could well be viewed as wasting money."